2000 CALIFORNIA PARTICULATE MATTER MONITORING NETWORK DESCRIPTION

PREPARED BY

Marcella Nystrom
Air Quality Analysis Section
California Air Resources Board
and
Michael Redgrave
Air Quality Data Section
California Air Resources Board

CONTRIBUTORS

Ron Rothacker
Ken Stroud
Karen Magliano
Norma Montez
Nehzat Motallebi, Ph.D.
Tom Pomales
Gabriel Ruiz
Clinton Taylor
Mac McDougall

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This is the third particulate matter monitoring network description report documenting $PM_{2.5}$ network design and implementation issues in California. On June 30, 1998, the Air Resources Board (ARB) and local air pollution control and air quality management districts (air districts) submitted the first report, the *1998 California Particulate Matter Monitoring Network Description*, to the Regional Administrator of the United States Environmental Protection Agency (U.S. EPA), Region IX (ARB, 1998). The first annual update to the 1998 report, the *1999 California Particulate Matter Monitoring Network Description*, was submitted to the U.S. EPA on June 30, 1999 (ARB, 1999). The current document, *2000 California $PM_{2.5}$ Monitoring Network Description*, fulfills the requirement for a year 2000 update.

The $PM_{2.5}$ monitoring network follows the regulations provided in Title 40 of the Code of Federal Regulations, Parts 50, 53, and 58 and published in the Federal Register on July 18, 1997. The goal of the $PM_{2.5}$ monitoring program in California is to provide ambient data that support the State's air quality programs, including mass measurements and speciated data. Data from this program will be used for identifying nonattainment areas, developing and tracking implementation plans, assessing regional haze, assisting in health effects studies, and supporting other ambient aerosol research activities.

This document provides an overview of the $PM_{2.5}$ implementation effort in California to date and addresses the network expansion proposed for the twelve month period starting July 2000, including the rationale for the various network components. During the last two years, the network activities focussed on establishing $PM_{2.5}$ mass monitoring sites to collect data for comparison with both the 24-hour and annual $PM_{2.5}$ National Ambient Air Quality Standards, establishing several $PM_{2.5}$ speciation monitoring sites to collect data for determining long-term trends of selected $PM_{2.5}$ constituents, and developing an infrastructure for the ongoing $PM_{2.5}$ program. The $PM_{2.5}$ monitoring program in California now has in operation 81 community-oriented $PM_{2.5}$ mass monitoring sites (21 of which are collocated sites for quality assurance and quality control purposes), and three federally-required $PM_{2.5}$ speciation sites, as well as seven fully equipped laboratories for weighing $PM_{2.5}$ Federal Reference Method (FRM) filters and a comprehensive quality assurance program.

This year's network description addresses the current status of the network and plans for expansion in three separate areas of $PM_{2.5}$ monitoring. These areas include $PM_{2.5}$ FRM mass monitoring, $PM_{2.5}$ continuous mass monitoring, and $PM_{2.5}$ speciation monitoring. The proposed activities in each of these areas are summarized below:

- **$PM_{2.5}$ FRM Mass Samplers**
  - Two sites remain to be established (Piru-Pacific Avenue in Ventura County and North-West Lake Tahoe). The Piru site should be operational by the end of 2000. A deployment date for the Lake Tahoe site is uncertain.
  - 20 sites are proposed for identification as National Air Monitoring Stations (NAMS). These sites will serve as long-term trends sites to be used in tracking progress toward attainment of the national $PM_{2.5}$ standards.
- **Continuous $PM_{2.5}$ Mass Monitors**
  - Approximately 22 sites are proposed for deployment of continuous $PM_{2.5}$ mass monitors. These 22 sites are in addition to the 15 sites already identified in the *1999 California Particulate Matter Monitoring Network Description*.
- **$PM_{2.5}$ Speciation Samplers**
  - The remaining four samplers in the NAMS speciation network will be deployed by the end of 2000.
  - The ARB is continuing to evaluate data to determine which speciation sampler(s) will be most suitable for deployment at California's State and Local Monitoring Stations (SLAMS). The evaluation is considering both filter-based samplers and continuous samplers. Based on the length of time required for the technologies to further develop, for field testing under California's high-season conditions, and for evaluating the results, it is likely that selection and deployment of samplers in the SLAMS $PM_{2.5}$ speciation network will not begin until 2001.
  - Following an initial evaluation of new technology for continuous speciation analyzers, the ARB has selected and ordered seven Rupprecht and Patashnick (R&P) 8400 Continuous Nitrate Analyzers, one R&P 5400 Carbon Analyzer, and one Andersen Instruments Continuous Speciated Ion Chromatography Unit. All of these samplers will be deployed at selected California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS) sites. At the close of CRPAQS, these analyzers will be integrated into California's $PM_{2.5}$ speciation monitoring network. The experience gained from field testing the monitors will help in designing the SLAMS speciation network.

While California's PM 2.5 monitoring network is still expanding, most of the existing sites have been in operation since early 1999 and now have a year's worth of $PM_{2.5}$ data. While one year of data is not sufficient for determining attainment or nonattainment status (three years of data are required for this), the existing data are sufficient for making some comparisons among the sites (refer to Chapter 4, Section B. 1. and Appendix C for a more complete discussion).

The preliminary 1999 data show that the highest 24-hour $PM_{2.5}$ mass concentrations vary widely throughout the State. The highest concentrations among sites with valid data for the year range from 20 micrograms per cubic meter ($\mu g/m^3$) at

San Luis Obispo-Marsh Street to 136 $\mu g/m^3$ at Fresno-1st Street. The average of quarters, or annual average, concentrations range from 7.9 $\mu g/m^3$ at Alturas-W 4th Street to 31.2 $\mu g/m^3$ at Bakersfield-5558 California Avenue. In general, both the highest 24-hour and annual average $PM_{2.5}$ concentrations are found at sites in the South Coast Air Basin and San Joaquin Valley Air Basin. Relatively high 24-hour measurements are also found in the San Francisco Bay Area Air Basin, the Sacramento Valley Air Basin, and certain parts of the Mountain Counties Air Basin. While the annual concentrations at sites in these areas are substantially lower than in the South Coast Air Basin and San Joaquin Valley Air Basin, the 1999 annual average concentrations at some sites in the Sacramento Valley Air Basin exceed 15 $\mu g/m^3$ which is the level of the national annual $PM_{2.5}$ standard.

On average, the highest 24-hour concentrations in 1999 occurred in January, November, and December, while the lowest concentrations occurred between March and August. Most of the Monitoring Planning Areas (MPAs) follow this seasonal pattern to some degree. The seasonality is most pronounced in the San Joaquin Valley Air Basin, where the January-November-December concentrations were on the order of 4 to 5 times greater than those for March through August. Less pronounced seasonality following this pattern occurred in the San Francisco Bay Area Air Basin, the San Diego Air Basin, the Sacramento Valley Air Basin, the North Coast Air Basin, the Mojave Desert Air Basin, and Imperial County. In other MPAs, the highest concentrations occurred throughout the year, though in most cases, these "high" values were low, when compared with those MPAs that showed seasonality. The two exceptions are the South Coast Air Basin and Coachella Valley, where fairly high values occurred throughout the year. As the $PM_{2.5}$ monitoring program continues and more data become available, more refined analyses will be possible, as well as definitive determinations of attainment and nonattainment status.

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CHAPTER 1

INTRODUCTION

Particulate matter (PM) has long been a concern for air quality officials because of its adverse impacts on health and visibility. PM is any material, except uncombined water, that exists in the solid or liquid state in the atmosphere. The size of particulate matter can vary from coarse wind blown dust particles to fine particle combustion products. PM is generally divided into two major categories: PM_{10} and $PM_{2.5}$. PM_{10} comprises particles with an aerodynamic diameter less than or equal to a nominal 10 microns (about 1/7 the diameter of a single human hair). Their small size allows them to make their way to the air sacs deep within the lungs where they may be deposited and result in adverse health effects. PM_{10} also causes visibility reduction. In contrast, $PM_{2.5}$ is a subset of PM_{10} and includes those particles with an aerodynamic diameter less than or equal to a nominal 2.5 microns. $PM_{2.5}$ is primarily a product of combustion. Particles within the $PM_{2.5}$ fraction of PM_{10} penetrate more deeply into the lungs, and cause the majority of the visibility reduction attributable to PM.

On July 18, 1997, the United States Environmental Protection Agency (U.S. EPA) promulgated new National Ambient Air Quality Standards (national standards) for PM in 40 Code of Federal Regulations (CFR) Parts 50 (U.S. EPA, 1997a), 53, and 58 (U.S. EPA, 1997b). The national PM standards apply to the mass concentrations of particles with aerodynamic diameters less than 2.5 microns ($PM_{2.5}$) and less than 10 microns (PM_{10}). The U.S. EPA regulations require that the states submit an annual $PM_{2.5}$ monitoring network description to their Regional Administrator by July 1. This document fulfills the requirement for the year 2000 annual update.

At this time, there is still some uncertainty about the future of the national PM standards as a result of the Court's decision in a legal challenge to the new standards. The American Trucking Association and several other industry groups challenged the standards on the basis of the U.S. EPA's failure to consider factors unrelated to health, including economic cost, in setting the national standards. Industry's view is that U.S. EPA is not prohibited from considering the broad economic, environmental, and indirect public health consequences of its action when it develops an 'intelligible principle' to govern the exercise of its risk management judgment under section 109 of the Clean Air Act (the section authorizing the U.S. EPA to promulgate national standards). On May 14, 1999, a U.S. Court of Appeals for the District of Columbia Circuit issued a ruling, part of which vacated the revised national standards for PM_{10} and asked for additional information to decide whether the national $PM_{2.5}$ standards should remain in place or be vacated. It is important to note that despite its ruling, the Court did not question the science on which the U.S. EPA relied in developing the new standards nor did it criticize the agency's decision making process.

After asking for further briefing on several issues, the Court ruled on June 28, 1999, that the national $PM_{2.5}$ standards should remain in place. As a result of its

interpretation of the Court's ruling, the U.S. EPA is continuing to move forward with its clean air programs. This includes continuation of the required $PM_{2.5}$ monitoring program. As monitoring efforts move forward, the U.S. EPA is continuing work to develop a PM criteria document.

The criteria document represents a compilation and scientific assessment of all available health and environmental effects information. This document is required for the U.S. EPA reevaluation of the national PM standards expected in 2002. At this time, it appears the U.S. EPA may recommend standards for both fine particles ($PM_{2.5}$) and coarse particles ($PM_{2.5}$ to PM_{10}). Fine particles are a better surrogate for the PM components most likely linked to mortality and morbidity effects at levels below the previous national PM_{10} standards, while high concentrations of coarse particles are linked to effects such as aggravated asthma.

At the same time the U.S. EPA is revisiting the national standards, California is gearing up to review the State Ambient Air Quality Standards (State standards). Senate Bill 25 (Chapter 731, Statutes of 1999) was signed by Governor Davis on October 7, 1999, and requires the Air Resources Board (ARB) to review all existing State standards to determine whether they adequately protect public health, including infants and children, with an adequate margin of safety. State standards found to be inadequate will be revised, based on a priority ranking. The requirements of Senate Bill 25 put a special emphasis on infants and children because they may be more susceptible to the health effects of air pollutants than adults. Reasons for their higher susceptibility include higher relative ventilation rates, narrower airways, developing organs and tissues, and greater exposure because of increased time spent outdoors. At this time, it is unclear what effect, if any, the requirements of Senate Bill 25 will have on the State PM standards.

As California moves forward with its PM monitoring program, it is clear that data from the $PM_{2.5}$ monitoring program will be useful for comparison with the national standards, development and tracking of implementation programs, assessments of regional haze, assistance for health effects studies, and other ambient aerosol research activities. During 1998 and 1999, the ARB and local air pollution control districts and air quality management districts (air districts) established a comprehensive network of community-representative $PM_{2.5}$ monitoring sites and developed an infrastructure for the program (ARB, 1998; ARB, 1999). The main network of $PM_{2.5}$ monitoring sites are sometimes referred to as "core" or "Federal Reference Method" (FRM) sites, which means they satisfy specific federal regulatory requirements. These requirements ensure that data from these sites are suitable for comparison with the national $PM_{2.5}$ standards. California's $PM_{2.5}$ monitoring network now includes 81 core monitoring sites. All 81 sites are designated as State and Local Monitoring Stations or SLAMS. In addition, the monitoring network includes 21 collocated FRM samplers for quality assurance and quality control purposes, three National Air Monitoring Stations (NAMS) speciation sites, and seven fully equipped laboratories for weighing $PM_{2.5}$ FRM filters. The monitoring program also includes a comprehensive quality assurance program.

During the next twelve months, the Ventura County Air Pollution Control District is planning to establish a $PM_{2.5}$ mass core monitoring site at Piru-Pacific Avenue. In addition, the ARB is planning to establish a core site at North-West Lake Tahoe; however, the deployment date for this site is uncertain because of problems in finding a suitable location. Deployment of these two new sites will bring the total number of core sites to 83. As stated earlier, all 83 sites are designated as core SLAMS. As a subset of the SLAMS, the ARB and local air districts are proposing to designate 20 of these as core NAMS. The core NAMS will provide valuable information for comparison of long-term, nationwide $PM_{2.5}$ mass trends.

In addition to establishing two additional core FRM sites, the ARB and local air districts plan to deploy other types of instruments at sites throughout the network, including continuous mass samplers and speciation samplers. The speciation network will include two components: NAMS for measurement of long-term trends of selected $PM_{2.5}$ constituents that are comparable nationwide, and SLAMS (which include the NAMS as a subset) to collect data needed for developing an effective State Implementation Plan (SIP). The NAMS sites and instrumentation will be selected in accordance with U.S. EPA directives and should be operational by the end of the year. In contrast to the NAMS, the ARB and local air districts have flexibility in choosing the suite of monitoring instruments to use in the SLAMS portion of the speciation network. The SLAMS portion of the speciation network will be phased in over the next several years, allowing time to evaluate newly emerging measurement technologies.

As in previous years, the statewide $PM_{2.5}$ monitoring network will be integrated with special monitoring studies planned for California, including the Fresno and Southern California Supersite Studies and the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS). Among other activities, these special studies will test and evaluate new monitoring methods not currently used in the routine monitoring of particulate matter.

The remaining sections of this document describe California's $PM_{2.5}$ monitoring network and related activities. Chapter 2 summarizes the $PM_{2.5}$ elements funded and deployed prior to June 30, 2000, while Chapter 3 describes additions to the network planned during the next twelve months. Chapter 4 outlines $PM_{2.5}$ data distribution and data analysis activities. Finally, Chapter 5 describes a number of $PM_{2.5}$-related efforts taking place here in California. Some of these programs were established to monitor fine particulate matter even before the U.S. EPA promulgated the national $PM_{2.5}$ standards. In addition to these chapters, there are four appendices. Appendix A provides a table of community-oriented State and Local Air Monitoring Stations in California along with operating agency, type of monitor, date of first valid sample, sampling schedule, and supporting lab. Appendix B includes a table of existing and proposed $PM_{2.5}$ monitoring sites in California and lists the types of $PM_{2.5}$ samplers operating at each site, including FRM, continuous mass, speciation, and dichotomous samplers. Appendix C includes a summary of preliminary data collected at sites in the $PM_{2.5}$ FRM mass network during 1999. Finally, Appendix D provides a list of acronyms used in this document. This document was prepared by the ARB and incorporates comments from the local air districts and the public.

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CHAPTER 2

SUMMARY OF $PM_{2.5}$ MONITORING NETWORK THROUGH JUNE 2000

A. Federal Reference Method (FRM) Mass Samplers

The primary objective of the $PM_{2.5}$ mass monitoring program is to identify areas where $PM_{2.5}$ concentrations exceed one or both of the national $PM_{2.5}$ standards (i.e., the national annual standard of 15 micrograms/cubic meter and the 24-hour standard of 65 micrograms/cubic meter) (U.S. EPA, 1997a). In 1998, the ARB and the local air districts began designing and deploying a comprehensive network of monitoring sites to collect data for comparison to both standards (ARB, 1998). The network currently includes 81 operational monitoring sites, referred to as core State and Local Air Monitoring Stations. Data from core sites are suitable for comparison with the national $PM_{2.5}$ standards and therefore, suitable for determining attainment and nonattainment status.

1. Network Design

For the purpose of planning a $PM_{2.5}$ monitoring network, the ARB and the local air districts initially divided California into 18 areas called Monitoring Planning Areas (MPAs). The MPAs provide the best divisions for $PM_{2.5}$ monitoring network planning based on an analysis of population, political boundaries, geography, and meteorology. With few exceptions, the boundaries of the MPAs correspond to the boundaries of the various air basins in California.

During the $PM_{2.5}$ network design process, five objectives were given highest priority. These objectives are:

- Satisfy the U.S. EPA core monitoring requirements.
- Represent California's air basins and provide geographical representation.
- Represent high concentrations in populated areas.
- Characterize emission sources in high concentration areas.
- Consider the need for particle measurements in ongoing special health studies.

The ARB and the local air districts analyzed all available information and developed a list of sites that would best satisfy these objectives. Preference was given to adapting existing sites to $PM_{2.5}$ monitoring. The optimal site locations were selected based on population, land use, climate, emission sources, transport, characteristics of the existing monitoring network, and ongoing health studies. The rationale for selecting each of the sites was described in the two previous network descriptions (ARB, 1998 and ARB, 1999).

The $PM_{2.5}$ network funded up to this time comprises 83 core monitoring sites (81 of which already are in operation). The *1999 California Particulate Matter Monitoring Network Description* (*1999 PM Network Description*) described a network of

82 monitoring sites. Since then, a sequential $PM_{2.5}$ FRM sampler manufactured by Andersen Instruments has been deployed at Echo Summit in the Mountain Counties Air Basin. This monitor, funded by the State of Nevada Division of Environmental Protection (NDEP), began collecting data on January 1, 2000. The NDEP is a member of a consortium of agencies that includes the Tahoe Regional Planning Authority, the Washoe County District Health Department, U.S. EPA, and the ARB. The group was formed as a result of the 1999 Lake Tahoe Presidential Forum to coordinate and enhance air monitoring activities in the Lake Tahoe Air Basin and to establish a long-term aerometric database that would be accessible to researchers, government agencies, and the general public. The Echo Summit site operates on a 1-in-3 day schedule and is expected to remain in operation for at least three years. Because it conforms with established criteria, U.S. EPA Region IX has agreed that this site should be included as part of California's core $PM_{2.5}$ monitoring network, bringing the total number of core sites to 83. As required by U.S. EPA regulations, each core site has a population-oriented location, a neighborhood scale of representation, and an approved FRM measurement method. Only data from core sites are eligible for comparison to both the annual and 24-hour national $PM_{2.5}$ standards.

In addition to collecting data for determining attainment status with respect to the national standards, many core sites satisfy other monitoring objectives, including transport assessment and assistance in health studies. Each of the California air basins has at least one core $PM_{2.5}$ mass monitoring site. Air basins with high population and expected high $PM_{2.5}$ concentrations have additional monitoring sites to provide better geographical representation.

2. Sampler Selection

The $PM_{2.5}$ mass samplers used in California's core $PM_{2.5}$ monitoring network have been identified as FRM samplers by the U.S. EPA. The State monitoring network includes three types of FRM samplers. All but one site in the network use either the sequential Reference Ambient Air Sampler (RAAS) 2.5-300 manufactured by Andersen Instruments or the single channel Partisol®-FRM Model 2000 sampler manufactured by Rupprecht & Patashnick (R&P). The sequential FRM samplers have been deployed for the most part in high population and/or high concentration areas to accommodate more frequent sampling (everyday or 1-in-3 day). The single channel FRM samplers have been deployed in less populated areas with estimated $PM_{2.5}$ concentrations below the national standards except for the Echo Summit sampler that was funded by NDEP. The ARB and the local air districts purchased these samplers through the National Procurement Contract.

A third type of FRM sampler, the sequential Partisol® Plus Model 2025 manufactured by R&P (primary sampler and collocated sampler), is operating at the Keeler-Cerro Gordo Road site in the Great Basin Unified Air Pollution Control District (APCD). The sequential RAAS manufactured by Anderson was initially deployed at this site; however, the Great Basin Unified APCD staff encountered persistent operational problems with the sampler that seemed to be associated with stormy and moist conditions. Many of the same parts on this instrument were replaced numerous times,

and the Great Basin Unified APCD was not able to get the sampler running for any extended period of time. As a result, the Great Basin Unified APCD purchased two sequential R&P samplers using funds from the Owens Lake budget. These monies are authorized under the Health and Safety Code section 42316 to provide funds for studying and mitigating the PM problem in the Owens Lake area. The sequential R&P samplers began operating at the Keeler site in May 2000.

Information about all the samplers in the core network is summarized in Table 1. Appendix A lists whether each site has a sequential sampler or a single channel sampler.

Table 1: $PM_{2.5}$ FRM Samplers in California's Core Monitoring Network

Sampler Type	Manufacturer	Number of Samplers by Function		
		Primary	QA/QC	Total
Sequential FRM	Andersen	66	16	82
Sequential FRM	R&P	1	1	2
Single Channel FRM	R&P	16	4	20
Total		83	21	104

3. Sampler Deployment

The installation of $PM_{2.5}$ core sites began in 1998 and is still continuing in 2000. The current deployment status is summarized in Appendix A. The samplers were deployed in a rough priority order as follows. The sites estimated to have the highest $PM_{2.5}$ concentrations in each MPA (based on data from dichotomous (dichot) samplers and/or PM_{10} data) were installed first. Areas with estimated $PM_{2.5}$ concentrations close to the national $PM_{2.5}$ standards and areas where $PM_{2.5}$ concentrations are highest during the fall and winter were also given high priority. Existing dichot sites were favored for early deployment in an effort to collect data for comparison of the dichot and FRM measurement methods. The dichot data will be used for an early indication about the attainment status. Another criterion for determining deployment was to ensure that each operating agency received at least one sampler early on to gain experience in operating the instrument.

The *1999 PM Network Description* (ARB, 1999) listed, in its Appendix A, the status of 82 core FRM monitoring sites as of June 1999. A "Sampling Begin Date" was listed for 72 of the sites, and the remaining ten sites were listed as "Not Started." Four of the ten sites were new sites proposed for deployment in 1999. Operations at the remaining six sites were delayed for various reasons that were outlined in the *1999 PM Network Description*. Since the *1999 PM Network Description* was submitted, the ARB and local air districts have started sampling at all but two of these sites (North-West Lake Tahoe in the Lake Tahoe Air Basin and Piru-Pacific Avenue in the Ventura County Air Pollution Control District). In addition, sampling was started at a new site at Echo Summit in the Mountain Counties Air Basin (refer to section A. 1.)

The recently deployed sites and the date of their first valid sample are summarized in Table 2 of this 2000 annual update. With the startup of these sites, there are now 81 operating sites in California's network of $PM_{2.5}$ FRM mass samplers. The locations of these 81 sites and the two sites remaining to be deployed are shown in Figure 1.

Table 2: $PM_{2.5}$ FRM Samplers Deployed Since 1999 PM Network Description

MPA/Site Location	Date of First Valid Sample
Bay Area AQMD Livermore-793 Rincon Avenue	12/02/99
Coachella Valley Palm Springs-Fire Station	01/01/00
Great Basin Unified APCD Mammoth Lakes-Gateway HC	Planned 06/00
Mojave Desert Air Basin Ridgecrest-Las Flores Avenue	06/26/99
Mountain Counties Air Basin Echo Summit	01/01/00
Mountain Counties Air Basin Truckee-Fire Station	03/31/99
San Joaquin Valley Unified APCD Bakersfield-"Southeast"	02/18/00
San Joaquin Valley Unified APCD Fresno-Pacific Avenue (formerly "Southeast")	01/13/00
South Coast Air Basin Mission Viejo-26081 Via Pera	06/08/99

4. Sampling Frequency

According to U.S. EPA monitoring regulations, everyday sampling is required at 29 core $PM_{2.5}$ sites in California (two sites per area over 500,000 population and one site per Photochemical Assessment Monitoring Station (PAMS) area) (U.S. EPA, 1997c). All other sites are required to sample once every three days. To facilitate the deployment of the $PM_{2.5}$ network, the U.S. EPA issued two memoranda outlining guidance on sampling frequency during 1998 and 1999. Based on these memoranda, fewer sites were required to sample everyday and some sites were allowed to sample less than once in three days. One or more core SLAMS must sample everyday through 1999 in the following areas.

- In each large metropolitan area (population greater than 1 million).
- In each medium metropolitan area (population between 500,000 and 1 million) without a $PM_{2.5}$ correlated acceptable continuous analyzer.
- In each PAMS area, collocated with a PAMS site during June-August.

Figure 1: $PM_{2.5}$ FRM Mass Monitoring Sites
(with Monitoring Planning Areas and Counties)

In addition, daily sampling was encouraged at one or more SLAMS sites in monitoring areas where violations of the 24-hour national $PM_{2.5}$ standard are anticipated, and it is believed that the 24-hour standard will be more difficult to attain than will be the annual standard. A 1-in-6-day sampling schedule was allowed at any Special Purpose Monitoring (SPM) site.

The ARB and the local air districts considered multiple factors before proposing a sampling frequency for each monitoring site. The main objective was to ensure that the data collected adequately support area designations, modeling, health studies, and other monitoring objectives. Daily sampling was recommended in areas with $PM_{2.5}$ concentrations close to the national standard (based on dichot data and/or PM_{10} data). In areas where 24-hour $PM_{2.5}$ concentrations are well above or below the 24-hour national standard on a seasonal basis (based on dichot data and/or PM_{10} data), the sampling frequency will be adjusted seasonally. In areas where 24-hour concentrations are below the 24-hour national standard year round (based on three or more years of $PM_{2.5}$ and/or PM_{10} data), the sampling frequency will be 1-in-6-day.

The current sampling frequencies are summarized in Appendix A. There are eleven monitoring sites in California sampling everyday for $PM_{2.5}$ on a year-round basis. Six additional sites sample everyday during the period of expected high $PM_{2.5}$ concentrations (October 1 through March 31). The remaining sites sample on a 1-in-3-day or 1-in-6-day schedule, depending on the type of sampling equipment and estimated level of $PM_{2.5}$ concentrations.

The current sampling frequencies reflect several changes from those listed in the *1999 PM Network Description*. The affected sites are located in the South Coast Air Basin and the Monterey Bay Unified Air Pollution Control District (APCD). The *1999 PM Network Description* listed all sites in the South Coast Air Basin as sampling on a 1-in-3 day schedule. However, five sites, Anaheim-Harbor Blvd, Azusa, Los Angeles-North Main Street, North Long Beach, and Riverside-Rubidoux, are now sampling everyday. The South Coast Air Quality Management District (AQMD) originally proposed an everyday schedule for these sites. However, due to problems with weight gains on the field blanks, the South Coast AQMD reduced the sampling frequency to 1-in-3 day sampling at these sites. The South Coast AQMD did this based on a recommendation from the U.S. EPA in a March 1999 email dealing with passive sampling in the $PM_{2.5}$ samplers.

The ARB and the local air districts routinely collect $PM_{2.5}$ mass results from trip blanks and field blanks that are sent to the monitoring sites with the sets of filters that are used for ambient air monitoring. The trip blanks are left untouched, and the field blanks are placed in the sampler without sample air being drawn through them. Both types of blanks are then returned to the lab with the other samples. During the initial months of monitoring, several local air districts, including the South Coast AQMD, measured weight gains on the field blanks that exceeded the field blank acceptance criteria of ± 30 micrograms. This passive sampling problem created the potential for reporting $PM_{2.5}$ concentrations higher than the actual ambient concentrations. Several factors may have contributed to the passive sampling results. Agencies working with the

manufacturer determined that the Delrin filter cassette rings that hold the teflon sample filters were contributing to sample filter weight gain. A rigorous cleaning procedure for the rings eliminated this source of field blank contamination. Also, the manufacturer reengineered the samplers to include a more effective filter and gaskets on the sampler housing. These sampler modifications now remove almost all of the dust in the air being drawn through the housing (not as part of the sample air flow) by the cooling fan that maintains ambient temperatures in the instrument housing. Subsequent monitoring provided the operators with additional experience and a better understanding of the samplers themselves. As a result, the problem of weight gains on the field blanks has been resolved. In January 2000, the South Coast AQMD resumed an everyday sampling schedule at the affected five sites.

In contrast to these five sites, the South Coast AQMD has decreased the sampling frequency at the Big Bear City site from 1-in-3 day to 1-in-6 day. Data collected at Big Bear show low $PM_{2.5}$ concentrations. During 1999, the annual average $PM_{2.5}$ concentration at this site was 10.3 micrograms per cubic meter ($\mu g/m^3$) and the maximum 24-hour concentration was 32.1 $\mu g/m^3$. Both values are relatively low, compared with the national $PM_{2.5}$ standards. As a result, the U.S. EPA Region IX approved a 1-in-6 day sampling schedule for the Big Bear site. The South Coast AQMD began the 1-in-6 day sampling frequency in February 2000.

In addition to the South Coast sites, the sampling frequency has also changed at the two sites in the Monterey Bay Unified APCD. Sampling at these two sites, Salinas-Natividad Road #2 and Santa Cruz-2544 Soquel Drive, began in January 1999 on a 1-in-3 day schedule. The 1999 monitoring data show a maximum 24-hour $PM_{2.5}$ concentration of 30.8 $\mu g/m^3$ and an annual concentration of 10 $\mu g/m^3$ at Salinas, while the data for Santa Cruz show maximum 24-hour and annual concentrations of 31.4 $\mu g/m^3$ and 9.4 $\mu g/m^3$, respectively. Similar to the situation in Big Bear, these values are relatively low and are below the levels of the national $PM_{2.5}$ standards. As a result, the Monterey Bay Unified APCD began sampling at these sites on a 1-in-6 day schedule in April 2000. The U.S. EPA Region IX agrees that a less frequent sampling schedule is appropriate for these sites and has approved this change.

5. Quality Assurance Plan and Audits

All of the agencies operating $PM_{2.5}$ monitors in California developed $PM_{2.5}$ Quality Assurance Project Plans (QAPPs) which are part of the overall network plan. The U.S. EPA has conditionally approved these QAPPs which cover administrative, laboratory, and field activities. Most districts referred to the ARB's QAPP rather than developing their own QAPP and included district-specific information and procedures as necessary. Before the California QAPPs receive full approval, the U.S. EPA must complete a part of the QAPP for which it is responsible, dealing with data quality objectives. Also, the ARB and U.S. EPA are in negotiations on how to satisfactorily meet the audit requirements.

a. Collocated Samplers

The purpose of collocated samplers and the FRM performance evaluation is to estimate the precision and bias of the various $PM_{2.5}$ samplers. The only change in collocated samplers from the *1999 PM Network Description* is at the Keeler-Cerro Gordo Road site in the Great Basin Unified APCD. The local air district replaced its collocated sequential Andersen sampler with a sequential R&P sampler because of persistent operational problems with the Andersen sampler (refer to section A. 2. for a more complete discussion).

According to 40 CFR Part 58, Appendix A, Section 3.5.2 (U.S. EPA, 1997d), at least 25 percent of $PM_{2.5}$ monitoring sites must operate collocated samplers for each method designation. The two kinds of sequential samplers and the single channel sampler used in California's $PM_{2.5}$ monitoring network all have different method designations. Therefore, to satisfy this requirement, the ARB and the local air districts have identified sixteen sites for collocated sequential Andersen FRM samplers (25% of 66), one site for the collocated sequential R&P FRM sampler (25% of 1), and four sites for collocated single channel FRM samplers (25% of 16) (refer to Table 1). The specific site locations are identified in Appendix A.

The ARB and the local air districts selected collocated $PM_{2.5}$ sites based on the following criteria listed in order of importance:

- Measured or estimated $PM_{2.5}$ concentrations.
- Diversity of operating agencies.
- Geographical representation.
- Practical considerations such as available space.

All collocated samplers summarized in the *1999 PM Network Description* continue to operate, with the exception of three. The first two are located in the Bay Area AQMD. Initially, collocated samplers in the Bay Area AQMD were located at San Francisco-Arkansas Street and San Jose-4th Street. The collocated samplers at these sites operated through December 31, 1999. At that time, the Bay Area AQMD relocated the samplers to Concord-2975 Treat Blvd and Redwood City. The Bay Area AQMD will continue operating the collocated samplers at these sites for the remainder of this year. The collocated sampler at Redwood City will then be moved back to San Jose-4th Street on January 1, 2001. The Bay Area AQMD proposes to leave the second collocated sampler at the Concord site, because of limited space available at San Francisco-Arkansas Street. The third change in the collocated samplers is at the Anaheim-Harbor Blvd site in the South Coast Air Basin. This is a temporary station and the South Coast AQMD has not been able to operate a collocated sampler because of space and power limitations. Collocated sampling will begin when a permanent site location is established sometime in late 2000 or early 2001. In the interim, the South Coast AQMD will operate the collocated sampler at the Azusa site.

b. $PM_{2.5}$ Laboratory Pre-Certification Program

In order to assure the quality of the $PM_{2.5}$ air monitoring data and to facilitate a timely initiation of laboratory operations, the ARB implemented a Laboratory Pre-Certification Program. The program includes a laboratory pre-certification questionnaire and an on-site visit of the laboratory. The laboratory pre-certification questionnaire addresses requirements that a laboratory conducting $PM_{2.5}$ mass analysis determinations must follow. The questionnaire also includes recommendations on how to improve the overall quality of a laboratory's $PM_{2.5}$ operations. The requirements are found primarily in 40 CFR Part 50, Appendix L, Section 8.0 (U.S. EPA, 1997e). Additionally, recommendations are found in U.S. EPA's Quality Assurance Handbook, Volume II, Method 2.12 (U.S. EPA, 1989). The pre-certification questionnaire helps laboratories become aware of what is necessary to assure good quality data. As a follow-up to the pre-certification questionnaire, staff from the ARB Quality Assurance Section conduct an on-site visit of the laboratory. Each laboratory must be pre-certified before submitting $PM_{2.5}$ data to the U.S. EPA Aerometric Information Retrieval System (AIRS) - Air Quality Subsystem (AQS).

The Great Basin Unified Air Pollution Control District laboratory was pre-certified in June 1999, and has taken over laboratory responsibilities for the two sites in the Great Basin Valleys Air Basin (Keeler-Cerro Gordo Road and Mammoth Lakes-Gateway HC). In addition, the Mojave Desert AQMD laboratory was pre-certified in June 2000 and will be responsible for weighing the FRM mass samples collected at Lancaster-W Pondera Street and Victorville-Armagosa Road. These two new laboratories join the five existing laboratories—Bay Area AQMD, ARB, San Diego County APCD, South Coast AQMD, and Ventura County APCD. All seven laboratories meet the necessary conditions for submitting data to the U.S. EPA AIRS-AQS. The methodology used to analyze the $PM_{2.5}$ mass samples collected on Teflon filters is summarized in the Standard Operating Procedure for Mass Analysis of Fine Particulate Collected on Teflon Filters included in the QAPP.

c. $PM_{2.5}$ Mass Analysis System and Performance Audits

The ARB Quality Assurance Section has implemented a $PM_{2.5}$ Laboratory Mass Analysis System Audit Program. The audit entails completion of a laboratory operations system audit questionnaire and an on-site inspection and assessment of the total measurement system (sample collection, sample analysis, data processing, etc.). Included with the system audit is a performance audit consisting of an on-site review to check the accuracy of the $PM_{2.5}$ filter weighing balance(s), and relative humidity and temperature sensors, and a check of the laboratory operations to verify their ability to generate data of acceptable quality. The performance audits are conducted annually, and following the initial system audit. The system audits and annual performance audits/checks will help to ensure comparable results among the laboratories.

d. Sampler Performance and System Audits of Field Samplers

The primary goal of an auditing program is to identify system errors that may result in suspect or invalid data. The audit procedures described here provide quantitative estimates of a $PM_{2.5}$ FRM mass sampler's performance. These quantitative values consist of the flow rate percent difference, the design flow rate percent difference, the ambient temperature difference, the filter temperature difference, and the barometric pressure difference. In addition, for multiple filter samplers, the audit procedures provide quantitative values of the inactive filter temperature difference and the dry gas meter (DGM) temperature difference.

The flow rate percent difference indicates the accuracy of the sampler's indicated flow rate by comparing the indicated flow rate measurement with the measurement from an audit transfer standard. The design flow rate percent difference determines how closely the sampler's flow rate matches the inlet design flow rate under ideal operating conditions. The ambient temperature, filter temperature, and barometric pressure differences reflect the difference between the audit measurement for temperature or pressure and the respective measurement indicated by the sampler.

A calibrated transfer standard mass flow meter (MFM) is used to measure the sampler's operational flow rate. The sampler's indicated flow rate is then compared with the actual flow rate indicated by the MFM. The sampler's indicated flow is also compared with the design flow rate of 16.67 liters per minute. Audit techniques may vary with different models of samplers due to differences in such things as sampler configuration and sampler software.

The purpose of a field sampler system audit is to check if the monitoring site meets $PM_{2.5}$ siting criteria and if the site and equipment are clean and properly maintained. The initial system audit consists of completing a Site Survey Report. Annually thereafter, during each sampler performance audit, the Site Survey Report is checked for accuracy and updated as necessary. As a result of an audit, data may be deleted or corrected, or siting or operation conditions may be changed.

The U.S. EPA requires four quarterly audits per year for all $PM_{2.5}$ FRM mass samplers. The ARB conducts one of the quarterly audits which consists of a performance audit and a system audit. The remaining three quarterly audits are conducted by local air district or contractor personnel.

e. National Performance Audit

The National Performance Audit Program is a quality assurance activity that is used to evaluate measurement system bias of the $PM_{2.5}$ FRM monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, Section 3.5.3 (U.S. EPA, 1997d). The strategy is to collocate a portable FRM $PM_{2.5}$ air sampling instrument within 1 to 4 meters of a routine NAMS/SLAMS air monitoring instrument, operate both monitors as required in the Federal Reference Method and standard operating procedures, and compare the results. The U.S. EPA

implemented this program, and each year 25 percent of the SLAMS/NAMS monitors are identified for performance evaluation at a frequency of four times per year.

B. Other Sampling Equipment

1. Continuous $PM_{2.5}$ Mass Samplers

Continuous $PM_{2.5}$ mass samplers collect diurnally resolved data. These data are useful for public reporting, understanding diurnal and episodic behavior of fine particles, background monitoring, and transport assessment. The *1999 PM Network Description* called for the ARB and the local air districts to deploy 10 continuous $PM_{2.5}$ mass samplers for public reporting and/or better temporal representation. The sites were selected based on high population density, estimated or measured high $PM_{2.5}$ mass concentrations, ongoing health studies, and ongoing studies designed to improve understanding of the physics and chemistry of high PM concentrations. Eight of the ten sites (Anaheim-Harbor Blvd, Escondido-East Valley Parkway, Los Angeles-North Main Street, Prescott Park, Riverside-Rubidoux, Sacramento-Del Paso Manor, San Francisco-Arkansas Street, and San Jose-4th Street) are required by regulation in metropolitan areas with population greater than 1 million. (The Prescott Park site in the Oakland Planning Metropolitan Statistical Area (PMSA) was contingent on receiving funding for additional site equipment under the U.S. EPA Environmental Monitoring for Public Access and Community Tracking (EMPACT) grant program. Because this funding did not go through, Prescott Park is no longer a candidate site, and another site in the Oakland PMSA will be sought.) Two additional continuous mass monitors were proposed for Fresno-1st Street and Yosemite Village. Currently, only one of the ten continuous $PM_{2.5}$ monitoring sites, Sacramento-Del Paso Manor, is operational. This site began collecting data during May 2000.

In addition to the sites above, continuous $PM_{2.5}$ mass monitors are also required for background monitoring and transport monitoring. The objective of the background monitoring is to quantify regionally representative $PM_{2.5}$ concentrations for sites located away from populated areas and other significant emission sources. Three background sites are proposed for California:

- **One in Northern California** (located at the existing Point Reyes National Seashore IMPROVE site).
- **Two in Southern California** (the first located at the existing San Rafael Wilderness IMPROVE site and the second located on San Nicolas Island).

None of the three background sites is currently operating. However, ARB anticipates that all three will be operational by the end of 2000.

Transport sites are intended to measure fine particle contributions from upwind source areas that move into a planning area. Due to the current uncertainty about the extent of transport and the best monitoring configuration for transport assessment, only

one transport corridor in California has been funded so far with 103 Grant monies. The corridor between the Bay Area AQMD and San Joaquin Valley Unified APCD via Altamont Pass was determined to be the most appropriate for this evaluation based on the following factors:

- Documented history of ozone transport.
- Availability of supplemental air quality and meteorological measurements from various special studies.
- Existing infrastructure.

The *1999 PM Network Description* included a transport assessment project that includes three monitoring sites: one at Altamont Pass and two at monitoring sites on opposite sides of the pass, in the Livermore and Tracy areas. Each site is to include a continuous $PM_{2.5}$ mass monitor and meteorological equipment. The Altamont Pass site is funded by the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study and is operating from December 1, 1999, through January 31, 2001. The continuous samplers at Livermore and Tracy were funded with the 1999 103 Grant. The meteorological equipment funded for the Tracy site included a new mast and a relative humidity instrument. The Livermore and Tracy sites were successfully moved in the last year, and the additional $PM_{2.5}$ network equipment has been purchased, but not yet installed. This equipment should be deployed during Summer 2000.

In addition to the continuous $PM_{2.5}$ mass monitors proposed in the *1999 PM Network Description*, two additional continuous samplers are currently operating in the Coachella Valley at Indio-Jackson Street and Palm Springs-Fire Station. These Beta Attenuation Monitors support the Coachella Valley Health Study and will remain with the South Coast AQMD when the study is complete. The South Coast AQMD plans to leave one of these monitors at the Indio-Jackson Street site and relocate the other monitor to a new site in the Anaheim area. In addition, a continuous PM_{10} mass monitor currently at the Palm Springs-Fire Station site will be modified for $PM_{2.5}$ and then relocated to the Banning-Airport site.

2. $PM_{2.5}$ Speciation Samplers

Speciation samplers provide valuable information about the composition (and ultimately sources) of $PM_{2.5}$ pollution. The chemical speciation network in California includes two components: National Air Monitoring Stations (NAMS speciation sites) for measuring long-term trends of selected $PM_{2.5}$ constituents and State and Local Air Monitoring Stations (SLAMS speciation sites) to collect data needed to develop an effective State Implementation Plan (U.S. EPA, 1999).

Federal regulations require seven speciation samplers in California as part of a nationwide network of NAMS speciation sites. The sites selected for this network are Bakersfield-5558 California Avenue, El Cajon-Redwood Avenue, Fresno-1st Street, Riverside-Rubidoux, Sacramento-Del Paso Manor, San Jose-4th Street, and

Simi Valley-Cochran Street. The rationale for selecting these sites is described in the *1999 PM Network Description*.

The U.S. EPA is funding the purchase of the NAMS speciation samplers. In addition, U.S. EPA has specified the types of samplers that may be used in order to ensure consistency and comparability of data throughout the nationwide network. In compliance with the regulations, Spiral Aerosol Speciation Samplers (SASS) were purchased and deployed at three of California's NAMS speciation sites:

- Fresno-1st Street,
- Sacramento-Del Paso Manor, and
- San Jose-4th Street

In addition to the SASS, a Reference Ambient Air Sampler (RAAS) was sited at Fresno-1st Street in April 2000. Both speciation samplers and the subsequent laboratory analysis provide particle mass, total carbon, elemental carbon, carbonate carbon, XRF metals, sulfate, nitrate, ammonium, sodium, and potassium.

Data collected at California's three NAMS speciation sites are being used in a "Mini-Trend Study" and instrument performance evaluation being conducted by the U.S. EPA, and also in support of the California Regional PM_{10}/ $PM_{2.5}$ Air Quality Study. The purpose of the Mini-Trends Study is to develop operational procedures for field, laboratory, and data management with regard to the national NAMS $PM_{2.5}$ speciation network. Another objective of the Mini-Trends Study is to gain operational experience with the RAAS and the SASS. In addition to the national study, the ARB is conducting its own evaluation of some of the U.S. EPA-recommended speciation samplers. Results of these studies will be used in selecting samplers for the remaining four NAMS speciation sites.

Most of the effort of designing the SLAMS speciation monitoring network will occur later in 2000 and into 2001. To date, the ARB has ordered some continuous speciation monitors to employ in upcoming evaluation studies. This equipment is being purchased without using Section 103 Grant funding. For a more complete discussion, refer to Chapter 3, Section C. 3.

3. Meteorological Equipment

The *1999 PM Network Description* proposed that meteorological equipment be added at the following sites: Redding-Health Department in the Sacramento Valley MPA, Ridgecrest-Las Flores Avenue in the Mojave Desert MPA, and Tracy in the San Joaquin Valley MPA. The meteorological data, along with FRM or continuous $PM_{2.5}$ mass measurements collected at these sites, will be used for transport assessment. The meteorological instruments needed for these sites include wind speed, wind direction, outside temperature, and relative humidity.

The meteorological equipment for the Redding and Ridgecrest sites has already been purchased. Instruments were deployed at Ridgecrest in October 1999, and they are currently operating. Deployment to the Redding site was delayed because of contract negotiations with the site building manager. A new contract has been approved, and deployment of the meteorological equipment is expected in October 2000. The status of the Tracy site was described earlier in this chapter in Section B. 1.

CHAPTER 3

PLANNED $PM_{2.5}$ NETWORK ACTIVITY

This section addresses each element of the $PM_{2.5}$ network for which expansion is planned during the next twelve months. Included are FRM mass samplers, continuous mass samplers, speciation samplers, background monitors, transport monitors, and the IMPROVE network. A summary of the main types of $PM_{2.5}$ monitoring instruments already located and proposed at each $PM_{2.5}$ monitoring site is included in Appendix B.

A. FRM Mass Samplers

FRM mass samplers provide measurements that can be compared with the national $PM_{2.5}$ standards. These measurements can then be used as a basis for designating areas as attainment or nonattainment for one or both of the national standards. As required by regulation, the FRM sites must be population-oriented, have a neighborhood or greater zone of representation, and use an approved FRM sampler.

1. SLAMS $PM_{2.5}$ Mass Sites

California's $PM_{2.5}$ FRM mass sampler network currently includes 81 of the 83 SLAMS that will be in the planned network. The remaining two samplers should be deployed during the next twelve months. One sampler, to be located in the north western portion of the Lake Tahoe Air Basin, will be collocated with a PM_{10} sampler and will be operated by the ARB. Several potential site locations were identified in residential areas in the town of Tahoma, but did not meet with public approval. Another site was identified in a protected area; however, there was no suitable place for locating the instruments. As a result, the search for a viable location is continuing. ARB expects this process will take some time and therefore, the deployment date is uncertain. The second sampler will be located at the Piru-Pacific Avenue site in the Ventura County APCD. This site was projected to begin sampling in May 2000. Because of local permitting problems, the start date was delayed and is now projected as August 2000.

In addition to the establishment of these two new sites, the South Coast AQMD plans to move the FRM sampler from the North Long Beach site to a new site in the South Long Beach area. Recent monitoring by the South Coast AQMD indicates higher levels of particulate matter in the area to the south of the current North Long Beach site. The South Coast AQMD also plans to relocate the temporary Anaheim-Harbor Blvd site to a permanent location somewhere in the Anaheim area.

2. NAMS $PM_{2.5}$ Mass Sites

Federal regulations require that some $PM_{2.5}$ mass monitoring sites within California be designated as NAMS trends sites. NAMS trends sites are long-term sites that can be used to track trends that establish progress toward attainment of the national standards. U.S. EPA Region IX has stated its intention of designating 25 to 40 sites within all of Region IX

(which includes California, Arizona, Nevada, Hawaii, and several Pacific islands) as NAMS sites for $PM_{2.5}$ mass. The regulatory requirements for selecting $PM_{2.5}$ NAMS sites from the SLAMS sites provide maximum flexibility to state and local agencies, and do not include any more specific guidelines. Final approval for designating sites as NAMS rests with U.S. EPA.

Table 3 lists those sites we propose U.S. EPA designate as NAMS trends sites. In accordance with the federal guidelines, we propose that 20 sites in California be designated as $PM_{2.5}$ NAMS sites. In choosing the sites, we preferentially selected sites that experienced high ambient concentrations in 1999 and sites located in areas with high populations. We also gave preference to those sites that have been in operation for several years (monitoring PM_{10}) and that are likely to remain in operation for the foreseeable future. Finally, we selected sites that broaden the geographical representation of the network and that have the most frequent sampling schedules. NAMS designation

Table 3: Sites Proposed for the $PM_{2.5}$ Mass NAMS Network

Monitoring Planning Area	Site Name	AIRS Site ID
Bay Area AQMD	San Francisco-Arkansas Street	060750005
	San Jose area [1]	
	Vallejo-304 Tuolumne Street	060950004
Great Basin Unified APCD	Mammoth Lakes-Gateway HC [2]	060510001
Imperial County APCD	Calexico-Ethel Street	060250005
Mountain Counties Air Basin	Quincy-N Church Street [2]	060631006
Sacramento Valley Air Basin	Sacramento-Del Paso Manor	060670006
San Diego County APCD	El Cajon	060730003
	San Diego-12th Avenue	060731007
San Joaquin Valley Unified APCD	Bakersfield-5558 California Avenue	060290014
	Fresno-1st Street	060190008
	Modesto-814 14th Street	060990005
	Stockton-Hazelton Street	060771002
	Visalia-N Church Street	061072002
South Coast Air Basin	Anaheim area [3]	New site
	Azusa	060370002
	Burbank-W Palm Avenue	060371002
	Los Angeles-North Main Street	060371103
	South Long Beach area [4]	New site
	Riverside-Rubidoux	060658001
Ventura County APCD	Simi Valley-Cochran Street	061112002

[1] The Bay Area AQMD and the ARB will coordinate on designating either San Jose-4th Street or San Jose-Tully Road when additional data are available for evaluation.

[2] Mammoth Lakes and Quincy are both potentially smoke-impacted and we propose that one should be designated as a NAMS. Before a decision can be made, the involved agencies will need to coordinate on this, and more data will be needed from the recently opened Mammoth Lakes site.

[3] The South Coast AQMD is relocating the Anaheim-Harbor Blvd site to a new site in the Anaheim area. The new site should be open near the end of 2000.

[4] The South Coast AQMD plans to move the $PM_{2.5}$ FRM sampler from the North Long Beach site to a new site in the South Long Beach area.

of a site in the San Jose area is still a bit uncertain. While San Jose-4th Street is a long-term site for several other pollutants, with a fairly complete suite of monitoring instruments, an evaluation of the preliminary 1999 monitoring data indicates that $PM_{2.5}$ concentrations are higher at the San Jose-Tully Road site. The ARB and the Bay Area AQMD will coordinate on designating one of these two sites as a $PM_{2.5}$ NAMS mass site when additional data are available for evaluation. Both agencies agree that more than one year of data need to be evaluated before making a final decision.

Federal regulations state that regional transport must be considered when designating NAMS $PM_{2.5}$ sites. Interstate transport of $PM_{2.5}$ and its precursors is a problem in the eastern United States, but is not anticipated to be a significant problem between California and other states. Instead, if significant transport does occur in California, its scope is expected to be between air basins within the State. In accordance with the *1999 PM Network Description*, we are evaluating the degree to which transport occurs between the San Francisco Bay Area and the San Joaquin Valley via the corridor between Livermore and Tracy. The ARB and affected local agencies will evaluate the need for expanded transport monitoring after examining the results from this corridor.

It is also the case that filter-based mass monitoring is not the preferred type of monitoring at transport assessment sites. The ARB and the local air districts in California intend to use continuous $PM_{2.5}$ mass monitors where transport monitoring is warranted. Because of the finer temporal resolution, continuous monitors are better suited to evaluating transport than are the 24-hour monitors. Limited, preliminary data from a multi-monitor study being conducted in Bakersfield suggests that the two methods correlate well, so determining a 24-hour "measurement" comparable to that from an FRM monitor may be possible.

B. Continuous Mass Monitors

As discussed in Chapter 2, Section B. 1., the *1999 PM Network Description* called for the ARB and the local air districts to deploy 10 continuous $PM_{2.5}$ mass monitors for public reporting and/or better temporal representation. These sites are being funded via a 1999 Section 103 Grant. This Section 103 Grant also supports continuous $PM_{2.5}$ mass monitors at two transport-related sites (Tracy and Livermore) and three background sites (Point Reyes National Seashore, San Nicolas Island, and San Rafael Wilderness). So, the *1999 PM Network Description* included allocations for a total of 15 continuous $PM_{2.5}$ mass monitors.

Over the next year, additional monitors will be available for deployment at other sites. The California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS) will release about seven monitors at the completion of that study in early 2001. ARB funding is available to support the purchase of nine additional monitors. A few districts have expressed interest in funding monitors for use within their own boundaries. To date, two districts, the South Coast AQMD and the Sacramento Metropolitan AQMD, have either committed to purchasing monitors or have existing continuous $PM_{2.5}$ mass monitors.

Finally, the California-Mexico Border Air Monitoring Program (Border Program) plans to use continuous $PM_{2.5}$ mass monitors, three of which may be included in California's permanent continuous $PM_{2.5}$ mass monitoring network (Calexico-East, Calexico-Ethel Street, and Otay Mesa).

In summary, a total of about 37 continuous $PM_{2.5}$ mass monitors are expected to be deployed throughout California by some time in 2001 as part of the California continuous $PM_{2.5}$ mass monitoring network. Of these 37 monitors, 21 are already committed between the *1999 PM Network Description*, local air district purchases, and the Border Program. This leaves about 16 continuous $PM_{2.5}$ mass monitors available for assignment.

Our plan includes equipping as many of the FRM NAMS with continuous $PM_{2.5}$ mass monitors as resources and priorities allow, as long as the agency operating the site is willing to operate the continuous $PM_{2.5}$ monitor. The actual sites proposed for continuous $PM_{2.5}$ mass monitors are listed in Table 4. The factors used to select sites for continuous $PM_{2.5}$ mass monitoring are the same as those used to designate sites for the FRM NAMS. In addition to the FRM NAMS sites, we plan to allocate one continuous $PM_{2.5}$ mass monitor to support an evaluation of the benefit of this type of monitor to the Sacramento Valley smoke management program. We also plan to allocate four monitors for collocated use to better understand the precision of the instruments under a variety of environmental conditions. Finally, we plan to retain one unassigned monitor to allow the rapid replacement of a deployed monitor that has broken down. Thus, about 11 sites could receive a continuous mass monitor during the coming 12 months from those purchased by the ARB and those available after CRPAQS. Note that the monitors that will become available from CRPAQS likely will be deployed predominately to sites in the Central Valley study domain. The total number of monitors affected and specific site locations are pending negotiation with the CRPAQS Policy Committee, and will be updated in next year's PM Network Description.

Deployment to the sites specified in the *1999 PM Network Description*, the FRM NAMS sites not listed in the *1999 PM Network Description*, the Sacramento Valley smoke management site, the collocated monitors, and the reserve monitor would, by the best estimate currently possible, require one more monitor than would be available. However, this estimate is tentative because we do not know at this time, exactly how many monitors will be made available from CRPAQS, the Border Program, or local air district purchases. If there are too few continuous $PM_{2.5}$ mass monitors available for deployment to the FRM NAMS sites, then some of the FRM NAMS sites will not be allocated a continuous monitor. If the estimate of available monitors is high, the allocations to the Vallejo-304 Tuolumne Street site, the Stockton-Hazelton Street site, and the Modesto-14th Street site would be subject to elimination. Another reason that these assignments should be considered tentative is that it is desirable to deploy the continuous mass monitors at sites that will have continuous speciation monitors, and this allocation will not be made for some time.

Table 4: Proposed Continuous $PM_{2.5}$ Mass Monitoring Sites in California

Monitoring Planning Area	Site Name	AIRS Site ID
Bay Area AQMD	**Livermore-793 Rincon Avenue**	060010007
	Oakland area [1]	Planned site
	Point Reyes	
	San Francisco-Arkansas Street	060750005
	San Jose area [2]	
	Vallejo-304 Tuolumne Street [3]	060950004
Coachella Valley	Indio-Jackson Street [4]	060652002
Great Basin Unified APCD	Mammoth Lakes-Gateway HC [5]	060510001
Imperial County APCD	Calexico-Ethel Street	060250005
	Calexico-East	060250006
Mountain Counties Air Basin	Quincy-N Church Street [5]	060631006
	Yosemite Village	060431001
Sacramento Valley Air Basin	Colusa-Sunrise Blvd [6]	060111002
	Elk Grove-Bruceville Road	060670011
	Sacramento-Del Paso Manor	060670006
	Yuba City-Almond Street [6]	061010003
San Diego County APCD	**Escondido-E Valley Parkway**	060731002
	Otay Mesa-Paseo International	060732007
	San Diego-12th Avenue	060731007
San Joaquin Valley Unified APCD	Bakersfield-5558 California Avenue	060290014
	Fresno-1st Street	060190008
	Modesto-814 14th Street [3]	060990005
	Stockton-Hazelton Street [3]	060771002
	Tracy	New site
	Visalia-N Church Street	061072002
Santa Barbara County APCD	**San Rafael Wilderness**	
South Coast Air Basin	**Anaheim area** [4]	New site
	Azusa	060370002
	Banning-Airport [4]	060650012
	Burbank-W Palm Avenue	060371002
	Los Angeles-North Main Street	060371103
	South Long Beach area [7]	New site
	Riverside-Rubidoux	060658001
Ventura County APCD	**San Nicolas Island**	
	Simi Valley-Cochran Street	061112002

Sites in **bold** were allocated a continuous $PM_{2.5}$ mass monitor in the *1999 PM Network Description.*

[1] The ARB and the Bay Area Air Quality Management District will coordinate on the selection of a site in west Oakland.

[2] The Bay Area AQMD and the ARB will coordinate on a decision to deploy a continuous $PM_{2.5}$ mass monitor to either the San Jose-4th Street site or the San Jose-Tully Road site.

[3] This site may not receive a State-provided continuous $PM_{2.5}$ mass monitor if insufficient monitors are available.

[4] Two continuous $PM_{2.5}$ mass monitors, currently deployed at the Indio-Jackson Street and Palm Springs-Fire Station sites as part of the Coachella Valley Health Study, will remain with the South Coast AQMD after the study. One will remain at the Indio-Jackson Street site and one will be relocated to a new site in the Anaheim area. A continuous PM_{10} mass monitor currently at the Palm Springs-Fire Station site will be modified for $PM_{2.5}$ and then be relocated to the Banning-Airport site.

[5] Mammoth Lakes and Quincy are both potentially smoke-impacted and we believe that a continuous $PM_{2.5}$ mass monitor should be deployed to one. Before a decision can be made, the involved agencies will need to coordinate on this, and more data may be needed from the recently opened Mammoth Lakes site.

[6] A continuous $PM_{2.5}$ mass monitor will be deployed to one of these sites to support the Sacramento Valley smoke management program.

[7] The South Coast AQMD plans to move the $PM_{2.5}$ FRM sampler from the North Long Beach site to a new site in the South Long Beach area. If possible, the continuous $PM_{2.5}$ mass monitor will also be located at the new South Long Beach site.

C. Speciation Samplers

Speciation samplers provide valuable information about the composition of $PM_{2.5}$ pollution. The chemical speciation network in California includes two components: NAMS speciation sites for measuring long-term trends of selected $PM_{2.5}$ constituents and SLAMS speciation sites for collecting the data needed to develop an effective State Implementation Plan (SIP). Plans for expanding both components are described in the following sections.

1. NAMS $PM_{2.5}$ Speciation Sites

Federal regulations require seven filter-based speciation samplers in California as part of a nationwide network of NAMS $PM_{2.5}$ speciation sites. Conforming speciation samplers have already been deployed at the following three sites: Fresno-1st Street, Sacramento-Del Paso Manor, and San Jose-4th Street. For a more complete discussion of the types of instruments currently operating in California's NAMS $PM_{2.5}$ speciation network and some of the work being done in support of the ARB's efforts to evaluate the samplers, refer to Chapter 2, Section B. 2. We anticipate that samplers for the four remaining NAMS $PM_{2.5}$ speciation sites will be purchased with previously allocated funds and deployed by the end of 2000. The four sites are:

- Bakersfield-5558 California Avenue
- El Cajon-Redwood Avenue
- Riverside-Rubidoux
- Simi Valley-Cochran Street

Selection of the NAMS speciation trends sites should be considered as tentative until sufficient FRM data from the California network are available for evaluation. The type of filter-based speciation sampler to be deployed at these four sites will, in part, be determined based on the U.S. EPA Mini-Trend Study and an ongoing ARB evaluation of the samplers. Results from the Mini-Trend Study are anticipated to be available in Summer 2000. It is desirable to have a continuous mass monitor located at the same sites at which continuous speciation monitors are deployed, and the NAMS speciation sites will be likely candidates for receiving continuous speciation monitors if they are deployed in California.

2. SLAMS $PM_{2.5}$ Speciation Sites

The second component of California's $PM_{2.5}$ speciation network is the selection and deployment of samplers at selected SLAMS. Data from these sites will provide additional information needed for developing an effective SIP. In determining the most appropriate locations for the SLAMS speciation samplers, the ARB will classify areas within the State into three categories depending on their need for speciation data for SIP development. The three categories are:

- **Areas likely to attain both national $PM_{2.5}$ standards.** There is no need to collect routine speciation data, other than NAMS speciation data, in the attainment areas.
- **Potential nonattainment areas with special studies.** Areas like Central California will collect sufficient data for SIP development through special studies. The seven NAMS, supplemented with additional equipment, will collect long-term trends data in these areas. They will require very little or no additional routine speciation monitoring.
- **Potential nonattainment areas with no special studies.** These areas will be the focus of the SLAMS $PM_{2.5}$ speciation network.

The ARB proposes a phased approach to deployment of the SLAMS portion of the speciation network. The first phase will evaluate sampling technologies. The one-month evaluation study at Bakersfield during January 1999 identified promising technologies. However, additional evaluation is needed before selecting monitoring technologies for the full SLAMS speciation network.

ARB is currently evaluating data to determine which speciation sampler(s) will best suit California's needs. The evaluation will consider both filter-based samplers and continuous samplers. There are pros and cons for each. Filter-based samplers would be less expensive initially (i.e., the equipment costs per site would be substantially less than with continuous samplers). This would allow the deployment of a larger number of samplers. In addition, filter-based samplers have multiple channels, allowing the collection of data for more species on a single instrument. On the other hand, filter-based samplers are at a particular disadvantage in situations where everyday speciation sampling is needed. In this case, sampling everyday over weekends can necessitate deploying four of the same type of sampler at each site. However, there does not appear to be any compelling reason for daily speciation sampling, and the ARB does not anticipate this being a substantial problem with the filter-based samplers.

In contrast to the filter-based samplers, the monitoring community in California is particularly interested in evaluating continuous monitors because this technology offers superior data resolution and reduced operation and maintenance costs when compared with filter-based samplers. Although continuous samplers would have a higher initial cost, they would be less expensive over the long-term. The continuous samplers require fewer staff to operate, facilitate everyday monitoring, and provide for better identification of sources. Continuous measurements also allow more refined estimates of exposure in community health studies. ARB recognizes that at this time, the technology for continuous samplers is not as reliable as for filter-based samplers. In addition, separate instruments may be needed for sampling nitrates, sulfates, and organics. Furthermore, since continuous samplers provide no elemental analysis, filter-based samplers would still be needed for these because the data are necessary for SIP development.

In order to gather the data needed for developing an effective SIP, California will need to take full advantage of emerging technologies. These technologies may include instrumentation that is not yet commercially available. Special monitoring studies such as the Fresno Supersite Study and the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study

are providing opportunities for testing and evaluating various continuous speciation sampling methods. However, based on the length of time required for the technologies to further develop, for field testing under California's high-season conditions, and for evaluating the results, it is likely that selection and deployment of samplers in the SLAMS $PM_{2.5}$ speciation network will not begin until 2001.

3. Continuous $PM_{2.5}$ Speciation Samplers

As part of an evaluation of new technology for continuous speciation analyzers, the ARB has selected and ordered seven Rupprecht and Patashnick (R&P) 8400 Continuous Nitrate Analyzers, one R&P 5400 Carbon Analyzer, and one Andersen Instruments Continuous Speciated Ion Chromatography (IC) Unit. The 8400 Nitrate and 5400 Carbon analyzers will be deployed at selected California Regional $PM_{10}/PM_{2.5}$ Air Quality Study sites by the end of Summer 2000, with the Andersen IC unit being deployed later, during Winter 2000/2001. At the close of CRPAQS, these analyzers will be integrated into California's $PM_{2.5}$ speciation monitoring network.

The R&P 8400 Continuous Nitrate Analyzer measures hourly averaged particulate nitrate values in $\mu g/m^3$ units. The 8400 Nitrate Analyzer operates by hydrating the ambient inlet airflow stream to help condense $PM_{2.5}$ particulate nitrate onto a small metal impaction plate. The deposited particles are flash vaporized followed by chemiluminescence (light emission) analysis.

The R&P 5400 Carbon Analyzer measures total carbon (TC), organic carbon (OC), and elemental carbon (EC), in $\mu g/m^3$. Each carbon component is measured using flash volatilization and an infrared CO_2 detector. Carbon collected on a high temperature impactor is vaporized and oxidized at elevated temperatures. The CO_2 detector measures the amount of carbon released as a result of sample vaporization and oxidation, first at 340 ^oC (OC), then the remainder at 750 ^oC. TC is the sum of OC and the remaining carbon vaporized and oxidized at 750 ^oC. The EC is measured by subtracting OC from TC. For the time being, the ARB will operate the continuous carbon analyzer in a field test mode to assess the performance and operational characteristics of the instrument.

The Andersen Instruments Continuous Speciated Ion Chromatography (IC) Unit will deliver hourly gaseous and particulate ions, mainly Cl, HCl, HONO, NO_2, HNO_3, NO_3, SO_2, SO_4, NH_3, and NH_4. This field IC unit will deliver values for each hour in $\mu g/m^3$ concentrations for each specific ion. The IC unit traps gaseous and particulate ions using wet denuder and steam saturation techniques, respectively. Once the ions are trapped in solution, each ionic compound is quantified using column separation technology and a conductivity detector.

D. Background Monitoring

Background sites are intended to quantify regionally representative $PM_{2.5}$ concentrations for sites located away from populated areas and other significant emission

sources. Background concentrations for the $PM_{2.5}$ program are defined as concentrations that would be observed in the absence of anthropogenic emissions of PM and the aerosol particles formed from anthropogenic precursor emissions of VOC, NO_x, and SO_x. Background monitoring data are important for developing control plans in areas expected to exceed the $PM_{2.5}$ standards. The following background sites in California will begin operation by December 31, 2000:

- **One Northern California background site.** To be located at the existing Point Reyes National Seashore IMPROVE site.
- **Two Southern California background sites.** One site to be located at the proposed San Rafael Wilderness IMPROVE site. The other site to be located on San Nicolas Island.

The Point Reyes National Seashore and San Rafael Wilderness monitoring sites will have IMPROVE samplers (filter-based samplers installed as part of the IMPROVE network) operating in parallel with continuous $PM_{2.5}$ mass samplers. By siting the $PM_{2.5}$ background monitoring at IMPROVE sites, analysts can take advantage of historical and current IMPROVE mass and speciation data. The IMPROVE data, along with continuous $PM_{2.5}$ mass data and meteorological measurements, will be useful in identifying divergences from background conditions, such as impacts of wildfires and sea salt. For example, the 1995 chemical speciation data from Point Reyes indicate that the largest contributor to fine particulate matter concentrations is sea salt (26%), followed by sulfate (18%), organic carbon (16%), and nitrate (13%). A strong correlation between sodium and chloride concentrations at this site indicates that both species come from the same emission source, most likely sea salt spray. The $PM_{2.5}$ concentrations further inland, where the sea salt spray is not expected to be a factor, can be estimated by subtracting the sea salt mass from the total mass measured at the coastal background site. The relatively strong seasonal variation in $PM_{2.5}$ species concentrations further supports the need for speciation sampling at background sites. At Point Reyes, sulfate concentrations were highest in the summer and lowest in the winter. Nitrate showed the opposite trend, with highest concentrations in the winter and lowest in the summer. The 1995 chemical speciation data from Point Reyes are more completely summarized in the *1999 PM Network Description*.

The third background site is to be located 80 miles off the southern California coast, on San Nicolas Island. Annual average PM_{10} Technical Enhancement Program (PTEP) data for 1995, collected by the South Coast Air Quality Management District, indicate that the largest contributor to fine particulate matter concentrations is sulfate (25%), followed by organic carbon (21%), ammonium nitrate (21%), and sea salt (18%). There is a relatively strong seasonal variation in $PM_{2.5}$ species concentrations. The 1995 chemical speciation data from San Nicolas Island were summarized in the *1999 PM Network Description*. It is unknown at this time what sources may be contributing to relatively high sulfate concentrations at this site. More data are needed to characterize the changes in the annual average concentrations, as well as the seasonal changes, and to identify sulfate sources. The monitoring site on San Nicolas Island is proposed to have a $PM_{2.5}$ speciation sampler and a continuous $PM_{2.5}$ mass sampler. The continuous $PM_{2.5}$ mass

sampler was funded with the 1999 Section 103 Grant. The ARB Research Division is donating a $PM_{2.5}$ speciation sampler, previously used in epidemiological studies, to the $PM_{2.5}$ monitoring program. This sampler requires minimal supervision, can be set-up to sample over an averaging period of weeks, and is easy to operate. These factors are very important in a remote location like San Nicolas Island.

E. Transport Monitoring

Additional equipment needs to be deployed to monitoring sites in the transport corridor between the Bay Area AQMD and the San Joaquin Valley APCD via Altamont Pass. This equipment was funded as part of the 1999 Section 103 Grant. The continuous $PM_{2.5}$ mass monitors at the Livermore and Tracy sites will be deployed during Summer 2000. The meteorological equipment for the Tracy site will also be deployed during Summer 2000. In addition to the transport assessment funded through the Section 103 Grant process, the Sacramento Metropolitan AQMD will be funding a continuous $PM_{2.5}$ mass sampler for the Elk Grove-Bruceville Road monitoring site in Sacramento County. This site will help to identify potential transport between the Bay Area and Sacramento via Bruceville.

F. IMPROVE Monitoring Network

In support of regional haze monitoring in national parks and wilderness areas, federal land management agencies operate the national IMPROVE air monitoring network. Chapter 5, Section G, of this report includes more background information about the IMPROVE program.

California IMPROVE sites will be used to support the regional haze program, and will complement the SLAMS $PM_{2.5}$ network, by collecting air quality data in remote locations. In 1999, the IMPROVE program in California began expanding to 17 sites. Of the 17 sites, 8 were existing sites. Table 5 provides an update of the IMPROVE network expansion in California as of May 1, 2000. The sites are listed from north to south.

To support this effort, the ARB is in the process of reviewing the existing and proposed new sites in the IMPROVE network to determine whether relative humidity sensors should be added to any of the sites. Relative humidity instruments may be needed at some IMPROVE sites to provide appropriate data for a calculation which relates the $PM_{2.5}$ and species concentrations measured by the IMPROVE samplers to a measure of visibility impairment.

The ARB also completed an analysis of annual average $PM_{2.5}$ concentrations at eleven of the California IMPROVE sites. Annual $PM_{2.5}$ concentrations varied from as little as 2.5 $\mu g/m^3$ at Lassen and Redwood National Parks to as high as 10 $\mu g/m^3$ (a significant fraction of the national annual $PM_{2.5}$ standard of 15 $\mu g/m^3$) at San Gorgonio

Wilderness which is downwind of urban Los Angeles. The analysis showed that low secondary aerosol and elemental carbon contributions are characteristic of the cleaner sites, while greater organic carbon fractions are seen at the sites with higher concentrations.

Table 5: Status of California's IMPROVE Network Sites

IMPROVE Site	Location and Status
Redwood National Park	Existing site located at Redwood National Park
Marble Mountain – Yolla Bolly	New site preparation in progress at Trinity Conservation Camp, northwest of Shasta Lake
Lava Beds – South Warner	New site installed at Lava Beds National Monument
Lassen – Thousand Lakes – Caribou	Existing site located at Lassen Volcanic National Park
Point Reyes [1]	Existing site located at Point Reyes National Seashore (ARB plans to install a real-time continuous $PM_{2.5}$ Beta Attenuation Monitor, together with surface meteorological instrumentation at this site by the end of 2000)
Pinnacles – Ventana	Existing site located at Pinnacles National Monument
D.L. Bliss – Desolation – Mokelumne	Existing site located at D.L. Bliss State Park
Kaiser – Ansel Adams	New site installed at Chinese Peak (Sierra Summit Ski Area)
Emigrant – Yosemite	Existing site located within Yosemite National Park
Hoover – "North" John Muir	New site preparation in progress at the Bureau of Land Management Conway Summit radio facility
Kings Canyon – Sequoia – "South" John Muir	Existing site located at Sequoia National Park
Dome Land	New site installed at Bureau of Land Management South Fork Fire Station near Onyx, California
San Rafael [1]	New site installed at U.S. Department of Agriculture Forest Service Figueroa Mountain Fire Station (ARB will install a real-time continuous $PM_{2.5}$ Beta Attenuation Monitor, together with surface meteorological instrumentation at this site by the end of 2000)
San Gabriel – Cucamonga	New site preparation in progress at U.S. Department of Agriculture Forest Service Vetter Mountain Fire Lookout
San Gorgonio – San Jacinto	Existing site located at San Gorgonio
Joshua Tree	New site established at Joshua Tree National Park
Agua Tibia	New site preparation in progress near Dripping Springs Campground

[1] Also a background monitoring site for California's $PM_{2.5}$ network.

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CHAPTER 4

DATA DISTRIBUTION AND ANALYSIS

A. Data Distribution

Data collected as part of the $PM_{2.5}$ network are available from the U.S. EPA Aerometric Information and Retrival System (AIRS) and the ARB air quality database (ADAM). The ARB has a very effective, customer oriented data distribution system that includes the following elements:

- **ARB Air Quality Website** (*www/arb/ca.gov/aqd/aqd.htm*) provides public access to ambient air quality data, maps of areas that violate the national and State standards, plans for $PM_{2.5}$ monitoring, and electronic versions of several of the reports described below.

- **Interactive data queries** of the entire California database are available from the website above or more directly at *www.arb.ca.gov/adam*. The user can query: 1) the top 4 values and the number of days above the standards for ozone, PM_{10}, dichot fine particles, CO, SO_2, and NO_2; 2) hourly data listings for a selected day for all gaseous pollutants; and 3) 10-week summaries of daily maximum data and other daily statistics. $PM_{2.5}$ summaries will be added by the end of 2000.

- **Predefined data tables** are available that include ozone data through 1998, PM_{10} data through 1997, and selected toxics data through 1996 at *www.arb.ca.gov/aqd/aqd.htm*. The ozone and PM_{10} web pages include maps for each air basin showing the location of monitoring sites. These pages include the highest values and counts of days exceeding the standards for each air basin, local air district, and monitoring site. The air basin and air district summary tables include data for 1980 and beyond, while the site summary tables include data for only the last several years.

- **1999 CD-ROM** contains hourly, daily, and/or annual summary data during 1980-1998 for ozone, CO, NO_x, NO, NO_2, SO_2, H_2S, THC, NMHC, CH_4, TSP, PM_{10}, dichot fine and coarse particles, COH, and b_{scat}, as well as speciated TSP, PM_{10}, dichot, and hydrocarbons. Toxics data for 1990-1998 are also included on the CD-ROM, as are a number of predefined annual reports which enable the user to quickly obtain key data, including approximately half of the annual Blue Sky report content and substantial portions of the State & Local Air Monitoring Network Plan. $PM_{2.5}$ FRM data will be added to an updated CD-ROM in Fall 2000. As with previous editions, there are two versions of the CD-ROM. The *Voyager CD* had maps and graphs for interactive browsing of the data, while the *Basic-Data CD* includes compressed ASCII hourly data as well as daily and annual data in ASCII and DBF formats. Both CD's have the predefined annual reports.

Additionally, the *Basic-Data CD* version contains user-friendly screens to display, print, or export a year of daily data for a single variable and location.

- **1999 California Almanac of Emissions & Air Quality** provides key ozone, PM_{10}, and CO indicators (expected peak day concentration, design values, annual averages, and number of exceedances) for counties and air basins, from 1980 through 1997. A few indicators for NO_2 and SO_2 are also included. $PM_{2.5}$ FRM data will be added in Winter 2000. An electronic version of the Almanac is available at *www.arb.ca.gov/aqd/almanac/almanac99.htm*. The web also provides access to a supplement that includes data through 1998.

- **State & Local Air Monitoring Network Plan**, February 2000, provides an inventory of current and historical air quality monitoring in California and Baja, Mexico, including $PM_{2.5}$ monitoring at all sites. A summary of instrument types and chemical analysis methods for criteria pollutants and maps are also included. The electronic version of the report is available on the web at *www.arb.ca.gov/aqd/namslams/namslams.htm*.

B. Data Analysis

Data derived from the $PM_{2.5}$ monitoring network include both aerosol mass measurements and chemically-resolved or speciated data. Mass measurements are used principally for identifying areas as attainment or nonattainment for the national $PM_{2.5}$ standards. The mass data will also be useful for assessing trends in ambient $PM_{2.5}$ concentrations. Speciated $PM_{2.5}$ data will be used to assess trends and develop emission control measures aimed at reducing aerosol emissions as they relate to the SIP. This involves emission inventory and air quality model evaluation, source attribution analysis, and tracking the success of emission control programs.

1. Preliminary 1999 $PM_{2.5}$ FRM Summary Statistics

The majority of sites in California's core $PM_{2.5}$ mass monitoring network began sampling in early 1999 and now have sufficient data for making some comparisons among the sites. The 1999 data are summarized in Appendix C. Please note that these 1999 $PM_{2.5}$ data are preliminary. Each site in the core $PM_{2.5}$ network is listed, regardless of the amount of data that has been collected. Appendix C lists the site name, AIRS site identification number, the highest 24-hour $PM_{2.5}$ measurement, the average of quarters (annual average), an indication of data completeness, the number of months represented, the number of quarters represented, and the total number of valid observations during 1999. The average of quarters and the indicator of data completeness were both calculated according to the methods specified in 40 CFR Part 50, Appendix N. While the data in Appendix C reflect only a single year (1999), the national $PM_{2.5}$ standards are based on three years of data and percentile averages. As a result, the available data are not yet sufficient for determining which areas are attainment and which areas are nonattainment.

The high 24-hour $PM_{2.5}$ mass concentrations measured throughout the State during 1999 reflect a wide range of values. The highest concentrations among sites with valid data for the year range from 20 $\mu g/m^3$ at San Luis Obispo-Marsh Street to 136 $\mu g/m^3$ at Fresno-1st Street. The average of quarters, or annual average, concentrations range from 7.9 $\mu g/m^3$ at Alturas-W 4th Street to 31.2 $\mu g/m^3$ at Bakersfield-5558 California Avenue. In general, both the highest 24-hour and annual average $PM_{2.5}$ concentrations are found at sites in the South Coast Air Basin and San Joaquin Valley Air Basin. Relatively high 24-hour measurements are also found in the San Francisco Bay Area Air Basin, the Sacramento Valley Air Basin, and certain parts of the Mountain Counties Air Basin. While the annual concentrations at sites in these areas are substantially lower than in the South Coast Air Basin and San Joaquin Valley Air Basin, the 1999 annual average concentrations at some sites in the Sacramento Valley Air Basin exceed 15 $\mu g/m^3$ which is the level of the national $PM_{2.5}$ standard.

On average, the highest 24-hour concentrations in 1999 occurred in January, November, and December, while the lowest occurred between March and August. Most of the Monitoring Planning Areas (MPAs) follow this seasonal pattern to some degree. The seasonality is most pronounced in the San Joaquin Valley Air Basin, where the January-November-December concentrations were on the order of 4 to 5 times greater than those for March through August. Less pronounced seasonality following this pattern occurred in the San Francisco Bay Area Air Basin, the San Diego Air Basin, the Sacramento Valley Air Basin, the North Coast Air Basin, the Mojave Desert Air Basin, and Imperial County. In other MPAs, the highest concentrations occurred throughout the year, though in most cases, these "high" values were low, when compared with those MPAs that showed seasonality. The two exceptions are the South Coast Air Basin and Coachella Valley, where fairly high values occurred throughout the year.

This contrast in PM concentrations is what makes the PM problem here in California so difficult and complex. The emission sources can be very diverse from one area to another. Furthermore, because of the variety of sources and the size and chemical composition of the particles, both the nature and causes of the PM problem can vary considerably from area-to-area. As a result, even though two areas may have similar concentrations, they may have very different PM problems. To add to the complexity, a single area may have a different type of PM problem during different times of the year. PM monitoring programs such as those required by the U.S. EPA will help in making strides toward understanding and controlling the PM problem.

2. Area Designations and Network Review

National Ambient Air Quality Standards apply to $PM_{2.5}$ and PM_{10} mass concentrations. The national PM standards specify the following limits:

- Twenty-four-hour average $PM_{2.5}$ not to exceed 65 $\mu g/m^3$ for a three-year average of annual 98th percentiles at any community-representative (core) site in a monitoring area.

- Three-year annual average $PM_{2.5}$ not to exceed 15 $\mu g/m^3$ from a single community-representative (core) site or the spatial average of eligible community-representative sites in a monitoring area.

- Twenty-four-hour average PM_{10} not to exceed 150 $\mu g/m^3$ for a three-year average of annual 99^{th} percentiles at any site in a monitoring area.

- Three-year average of annual arithmetic means of PM_{10} concentrations not to exceed 50 $\mu g/m^3$ at any site in a monitoring area.

As discussed in the "Introduction" section of this document, the national $PM_{2.5}$ and PM_{10} standards are on hold, pending resolution of a legal challenge.

In contrast to the national PM standards, California has set its own State standards for PM_{10}, but not for $PM_{2.5}$. The designation criteria for the State standards specify the following limits:

- Twenty-four-hour average PM_{10} not to exceed 50 $\mu g/m^3$ during a three-year period at any site in a monitoring area, excluding exceedances affected by highly irregular or infrequent events.

- Annual geometric mean of PM_{10} concentrations not to exceed 30 $\mu g/m^3$ during a three-year period at any site in a monitoring area.

The first official national $PM_{2.5}$ area designations will take place in the year 2002 or 2003, based on three full years of FRM data for $PM_{2.5}$. These designations will be updated annually as new information becomes available. As $PM_{2.5}$ data are collected, values exceeding the national 24-hour $PM_{2.5}$ standard will be evaluated for influence by natural/exceptional events. The U.S. EPA allows $PM_{2.5}$ data that meet established natural/exceptional events guidelines to be excluded from the designation process. Due to the current lack of sufficient $PM_{2.5}$ FRM data, initial estimates of the attainment status of areas throughout California will be based on available dichot data and PM_{10} data.

California's statewide $PM_{2.5}$ network will be evaluated annually to assess the adequacy of the spatial and temporal coverage of the network. Any changes to the network, including site additions, site deletions, changes to sampling frequency, and monitor designation, will be documented.

3. Air Quality Trends and Source Attribution

For roughly a year until January 2000, the monitoring network in California included 16 sites operating $PM_{2.5}$ FRM samplers in parallel with dichot and PM_{10} SSI samplers. There are over ten years of dichot and PM_{10} data at many of these sites. The $PM_{2.5}$ FRM, dichot, and PM_{10} SSI mass data can be compared to evaluate the extent to

which these data correlate. The correlation can be examined under different atmospheric conditions, including high and low sampling temperatures and high and low relative humidities for each season. Changes in the correlation of the mass measured using different sampling methods can also be evaluated as a function of the dominant $PM_{2.5}$ fraction (primary versus secondary). If there is a good correlation between FRM and dichot or PM_{10} SSI data, historical data can be used to estimate long-term trends in the $PM_{2.5}$ FRM concentrations.

Speciation data from these samplers can be analyzed for the annual trends in $PM_{2.5}$ constituents and for changes in relative contribution of species to total mass. The speciation data will be critical for determining sources and their relative contributions to PM problems. The ARB proposes several specific projects, including:

- Conduct Chemical Mass Balance modeling to determine sources and their relative contributions to PM problems.
- Conduct analyses (e.g., $PM_{2.5}$ FRM/dichot comparisons, $PM_{2.5}/PM_{10}$ fractions) to assess the quality and improve the utility of the PM monitoring program.
- Analyze causes (e.g., rainfall, precursor controls) of declining annual average PM_{10} and $PM_{2.5}$ concentrations.
- Determine if there is a weekday/weekend effect for PM due to lower diesel NO_x and PM emissions.
- Compare $PM_{2.5}$ FRM and dichot data to determine if dichot data can be used to develop long-term $PM_{2.5}$ trends.
- Compare $PM_{2.5}$ FRM, dichot, and Children's Health Study Data to determine relationships between the methods.

The ARB has already completed a preliminary analysis for the last item. The results of this analysis are described in the following paragraphs.

The Children's Health Study *("Epidemiologic Investigation to Identify Chronic Health Effects of Ambient Air Pollutants in Southern California"*) is a three-phase, 10-year study to determine whether long-term exposure to air pollution in southern California is responsible for chronic respiratory effects in children (Peters, et al., 1994; Lurmann, et al., 1994). One of the objectives of the study is to characterize the population's exposure to air pollution at the community and personal levels. Based on student populations and pollutant levels, 12 communities were chosen for monitoring. They are Atascadero, Santa Maria, Lompoc, Glendora (substituted for San Dimas in 1996), Upland, Long Beach, Mira Loma, Riverside, Lake Elsinore, Lake Arrowhead, Lancaster, and Alpine. The air pollutants measured at all communities are ozone, nitrogen dioxide, nitric acid, hydrochloric acid, formic acid, acetic acid, PM_{l0} mass, $PM_{2.5}$ mass, chloride, nitrate, sulfate, and ammonium. The communities were chosen to provide a wide diversity of the pollutants of interest, ranging from low levels of all pollutants (Atascadero, Santa Maria, and Lompoc) to high levels of all pollutants (Glendora and Upland), and including communities with mixed profiles (such as Lake Arrowhead, with high ozone and low nitrogen dioxide, acids, and PM_{10} and $PM_{2.5}$ mass).

Three sites, Atascadero, Santa Maria, and Lompoc, are semi-rural communities with few local air pollution sources and are considered to be "clean" communities, relative to all the other sites, for the purposes of the Children's Health Study. A second set of sites, Lake Elsinore, Lake Arrowhead, Lancaster, and Alpine, have few local air pollution sources, but receive transport of pollutants from upwind urban areas. Lake Elsinore, Lake Arrowhead, and Lancaster receive transport from the Los Angeles basin; Lake Elsinore also receives transport from San Diego. Alpine receives transport from San Diego and Mexico. Finally, Glendora, Upland, Riverside, Mira Loma, and Long Beach are urban sites with local air pollution sources and transport of pollutants from neighboring urban areas. Mira Loma has unique chemistry within the network in that it is located close to animal feed lots, a major source of ammonia and dust. Long Beach is subject to summer fog and marine influences in addition to local sources of pollution.

Because estimates of long-term average concentrations (seasonal and annual) of vapor-phase acids and $PM_{2.5}$ mass and inorganic ions were needed, it was decided that two-week integrated sampling would be more appropriate than 1-in-3 day or 1-in-6 day sampling. The use of continuously operated samplers was expected to reduce off-gassing of volatile species which occurs with single-day samplers when the sampler is not running. The processing and analysis of two-week integrated samples would also be more cost-effective. The two-week sampler (TWS) used in this study has three independent sampling legs: Leg A to collect nitric acid, hydrochloric acid, and $PM_{2.5}$ mass and inorganic ions; Leg B to collect formic and acetic acid; and Leg C to collect particles for organic and elemental carbon analysis (see Figure 2). The first two legs operate at 0.4 liters per minute to give a sample volume of approximately 8 m^3 over a two-week period; the third leg operates at 1.3 liters per minute to give a sample volume of 26 m^3 over a two-week period. Leg A is described because it is the only leg which measures $PM_{2.5}$ mass and ions. The Leg A sample cassette (shown in Figure 3) contains a Teflon impactor followed by a sodium-carbonate-coated glass honeycomb denuder, a Teflon filter, and a sodium-carbonate-impregnated quartz-fiber backup filter. Nitric and hydrochloric acid are collected by the denuder, fine particles (<2.5 microns aerodynamic diameter) by the Teflon filter, and volatilized nitrate (from the Teflon filter) is collected by the sodium-carbonate-impregnated quartz-fiber backup filter. Nitrate captured by the backup filter is assumed to have come solely from volatilization of ammonium nitrate off the preceding Teflon filter. $PM_{2.5}$ nitrate is defined as the sum of nitrate measured on the Teflon filter and nitrate measured on the backup filter. Ammonium is not directly measured on the backup filter; instead, it is assumed to be equivalent to the nitrate on the backup filter. $PM_{2.5}$ ammonium, therefore, is defined as the sum of ammonium measured on the Teflon filter and ammonium calculated to have come from the backup filter. $PM_{2.5}$ mass is defined as the sum of gravimetric mass measured on the Teflon filter and the sum of nitrate measured on the backup filter and ammonium calculated to have come from the backup filter.

Since the TWS is unique, it is desirable to compare its performance to other, more routine monitors. However, as the TWS yields a two-week integrated measurement, the best comparison would be from either a continuous $PM_{2.5}$ monitor or a sequentially-operated $PM_{2.5}$ monitor. Such comparisons would provide valuable information about

the reliability of the mass concentrations measured by the TWS. The comparisons that we have been able to make have been with collocated FRM and/or dichot samplers at Long Beach, Atascadero, and Lancaster. At Long Beach, $PM_{2.5}$ mass from the TWS was compared to $PM_{2.5}$ mass from the fine dichot sampler and from the FRM mass sampler for 1999. At Atascadero, $PM_{2.5}$ mass from the TWS was compared to $PM_{2.5}$ mass from the FRM sampler for the same period. At Lancaster, $PM_{2.5}$ mass from the TWS was compared to $PM_{2.5}$ mass from the FRM sampler for the first three quarters of 1999.

At Long Beach, the TWS produced a mass concentration of 16.8 $\mu g/m^3$, the fine dichot sampler 17.2 $\mu g/m^3$, and the FRM sampler 19.7 $\mu g/m^3$. At Atascadero, the TWS produced a mass concentration of 7.6 $\mu g/m^3$ and the FRM sampler 9.6 $\mu g/m^3$. At Lancaster, the TWS produced a mass concentration of 6.2 $\mu g/m^3$ and the FRM sampler 11.0 $\mu g/m^3$. TWS mass values at Long Beach, therefore, agreed to within 2% of the fine dichot sampler values and to within 15% of the FRM mass sampler values. There was somewhat less agreement (21%) between the TWS and the FRM sampler at Atascadero and considerably less agreement (44%) between the TWS and the FRM sampler at Lancaster. It is currently projected that the TWS monitoring program for the Children's Health Study will be shut down by the end of 2001. Therefore, two more years of comparisons between the TWS and the FRM sampler at Long Beach, Atascadero, and Lancaster are anticipated.

Figure 2: Schematic of the Two-Week Sampler Showing Sampling Head and Flow Control Module

Sampled air enters the sampling cassettes, then passes through the rotameters and flow-limiting orifices to a pumping manifold. Flow split among the three sampling lines is controlled by the orifices; total flow is controlled by the needle valve at the pump (adapted from Lurmann, et al., 1994).

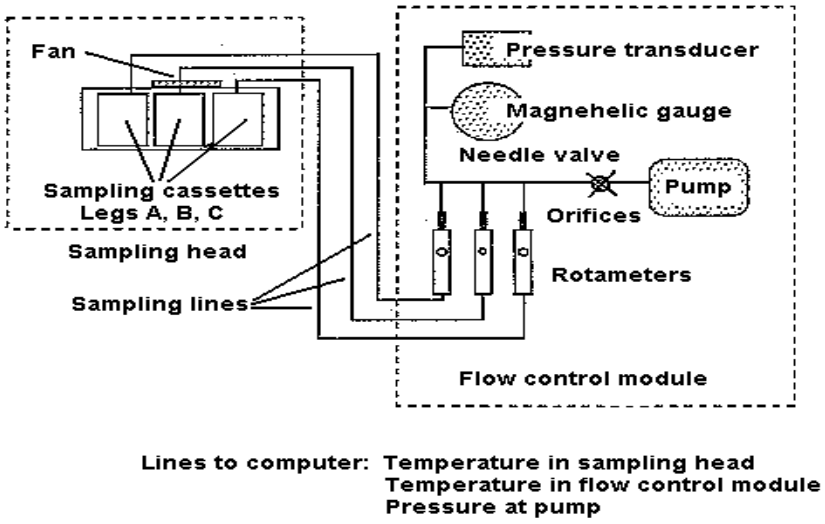
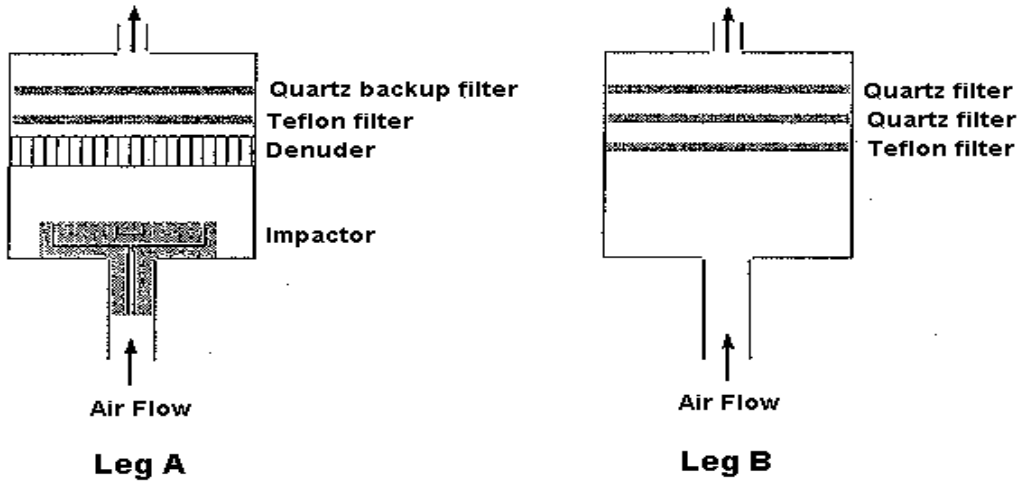


Figure 3: Sampling Cassettes for the Two-Week Sampler

Sampling cassettes for the two-week sampler, showing substrates for Leg A (used for measuring nitric acid, hydrochloric acid, and fine particle mass and ions) and for Leg B (used for measuring formic and acetic acids) (adapted from Lurmann, et al., 1994).



CHAPTER 5

RELATED $PM_{2.5}$ MONITORING EFFORTS IN CALIFORNIA

In addition to the federally mandated $PM_{2.5}$ monitoring program, there are several other $PM_{2.5}$ monitoring programs in California, some of which predate the promulgation of the national $PM_{2.5}$ standards. A summary of particulate matter monitoring resources in California can be found in *The State & Local Monitoring Network Plan* (ARB, 2000). The following sections describe seven monitoring programs that have included monitoring of fine particles. These monitoring programs are: the U.S. EPA's PM Supersites, the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS), the California-Mexico Border Air Monitoring Program, California's dichotomous (dichot) sampler network, the California Acid Deposition Monitoring Program (CADMP), the South Coast AQMD's PM_{10} Technical Enhancement Programs (PTEP and TEP 2000), and the Interagency Monitoring of PROtected Visual Environments (IMPROVE) monitoring program. In addition to these more long-term programs, many areas of the State have had special fine particle monitoring programs of limited (i.e., one year or less) duration.

A. PM Supersites

The U.S. EPA is establishing four to eight Supersites located in urban areas throughout the United States. These Supersites include an extensive array of monitoring equipment. Data collected at the Supersites will complement information from the statewide PM networks and will help in better understanding particle measurement technologies, source contributions, control strategies, and the health impacts of suspended particles. Two Supersites have been established in California--one in Fresno and one in southern California. While the ARB does provide support for the two Supersites in California, we do not have any direct control over the types of information collected or the overall program objectives. As a result, the descriptions of the Fresno and southern California PM Supersites are included for informational purposes only.

1. Fresno PM Supersite

The Fresno PM Supersite is one of two prototype Supersites established during 1999. The first phase at this site was initially set to run through March 31, 2001. However, the information collected during this phase will not be sufficient to support health studies planned for California. As a result, Phase 2 was initiated to enhance the measurements begun in Phase 1 and to accommodate the needs of simultaneous health-related studies in the Fresno area. Phase 3 will extend monitoring through March 31, 2003 and will fully integrate the Fresno Supersite measurements with those from other Supersites and with simultaneous health-related studies. The following three objectives have been established for Phase 2 and Phase 3:

- Test and evaluate non-routine monitoring methods, with the intent of establishing their comparability with existing methods and determining their applicability to air quality planning, exposure assessment, and health impact determination.
- Increase the knowledge base of aerosol characteristics, behavior, and sources so regulatory agencies can develop standards and strategies that protect public health.
- Acquire measurements that can be used to evaluate relationships between aerosol properties, co-factors, and observed health end-points.

Based on these objectives, a number of hypotheses have been developed. Exploring these hypotheses will require a multi-year data set that includes large extremes in meteorology, aerosol composition, and emissions.

Six hypotheses have been set forth for Objective 1:

1) $PM_{2.5}$ and PM_{10} measurements by different methods are comparable.
2) Mass from number count equals gravimetric mass.
3) Hourly coarse particle concentrations can be reliably determined from continuous PM_{10} and $PM_{2.5}$ measurements
4) Bioaerosols and endotoxins comprise a constant fraction of coarse particle mass.
5) Photoionization measurements are correlated with organic particle concentrations.
6) Chemiluminescent NO_2 is equivalent to true NO_2.

The five hypotheses for Objective 2 are:

1) Statistical aggregates of particle indicators for a single year deviate by less than sampling error from a three-year distribution.
2) Continuous carbon measurements differentiate carbon sources from each other.
3) Statistical indicators of source contributions do not significantly vary from year-to-year.
4) Particle size, number, surface area, and major chemical component indictors are highly correlated and are equivalent indicators of health risk.
5) $PM_{2.5}$ and PM_{10} mass concentrations were higher during drought years than during years with normal precipitation.

Finally, the Objective 3 hypotheses are:

1) Respiratory and cardiovascular distress are related to $PM_{2.5}$ concentrations and other indicators.
2) Concentration thresholds exist for air quality indicator relationships to health effects

3) Particle characteristics have different effects on the onset and severity of short-term reductions in lung function, asthma attacks, and cardiovascular ailments.
4) Animals react differently to different particle size, surface area, chemical, and mass characteristics.
5) Particles in human lungs are similar to those in urban air.

The Objective 3 hypotheses will be tested in concurrent epidemiological, toxicological, exposure, and clinical studies that will use measurements from the Fresno PM Supersite in real time to conduct experiments and to retrospectively analyze the results.

The Fresno PM Supersite includes an extensive suite of instruments for measuring $PM_{2.5}$, PM_{10}, and coarse (PM_{10} minus $PM_{2.5}$) mass; $PM_{2.5}$ sulfate, nitrate, carbon, light absorption, and light extinction; particle size distribution; criteria pollutant gases (ozone, CO, NO_x); reactive gases (NO_y, NO_2, HNO_3, NH_3); and single particle characterization by time of flight mass spectrometry. Field sampling and laboratory analysis are applied for gaseous and particulate organic compounds (light hydrocarbons, heavy hydrocarbons, carbonyls, polycyclic aromatic hydrocarbons, and other semi-volatiles); and $PM_{2.5}$ mass, elements, ions, and carbon. Measurements common to other PM Supersites will also be taken at Fresno, including: 1) daily $PM_{2.5}$ 24-hour average mass with FRM samplers; 2) continuous hourly and five minute average $PM_{2.5}$ and PM_{10} mass with Beta Attenuation Monitors (BAM) and Tapered Element Oscillating Microbalances (TEOM); 3) daily $PM_{2.5}$ chemical speciation with an EPA speciation monitor and protocol; 4) coarse particle mass by dichotomous sampler and the difference between PM_{10} and $PM_{2.5}$ BAM and TEOM measurements; 5) coarse particle chemical composition; and 6) high sensitivity and time resolution of scalar and vector wind speed, wind direction, temperature, relative humidity, barometric pressure, and solar radiation.

In addition to the primary Fresno site, three satellite sites are operated next to a nearby heavily traveled roadway, in a nearby neighborhood that is influenced by wintertime wood burning, and in a non-urban area south of the Fresno city limits. These sites will be used for evaluating deviations in Supersite measurements owing to source proximity and isolation from urban emitters. The satellite sites are equipped with nephelometers operating continuously and with Minivol Teflon and Quartz filter samplers operating for 24-hours every sixth day to quantify mass, elemental, ion, and carbon concentrations. Data analysis activities have been defined that relate every set of measurements to the hypotheses that will be tested.

A number of results are expected from the Fresno PM Supersite monitoring program, including:

1) A long-term record of simultaneous advanced particle measurements that includes a large range of concentration levels, particle sizes, and aerosol compositions, suitable for many purposes.
2) Supportable conclusions about specific hypotheses concerning measurement method performance, causes of excessive pollution levels, and health effects.

3) Continuing linkages and collaboration among air quality scientists, toxicologists, epidemiologists, exposure specialists, and clinicians that better integrate and communicate their scientific findings.
4) A research infrastructure in California that can serve research needs after Supersite monitoring is completed.
5) Peer-reviewed, scientifically sound publications that support local, State, and national decision-making related to standard setting and pollution controls.

The ARB has committed substantial support for site operation, quality auditing, and data management. In addition, there are a number of planned and pending health studies that will use the Supersite data including: 1) Particulate Air Pollution and the Natural History of Childhood Asthma; 2) Particulate Air Pollution and the Natural History of Adult Asthma; 3) Estimating Indoor Exposure from Ambient Concentrations; 4) Health Effects of Concentrated Ambient Particles from the Central Valley of California; and 5) Relationships Among Air Quality Indicators and Medical Health Records. These projects have certain or pending support from the ARB, the Department of Energy, the U.S. EPA, and various other sources.

2. Southern California PM Supersite

The southern California PM Supersite is the second Supersite established in California. It does not comprise a single location, but rather a number of satellite locations situated throughout the southern California area. This PM Supersite began operation in January 2000 and will continue until the end of 2004. The overall objective of the southern California PM Supersite (SCPMS) is to conduct research and monitoring that contributes to a better understanding of the measurement, sources, size distribution, chemical composition and physical state, spatial and temporal variability, and health effects of suspended particulate matter in the Los Angeles basin. The three research objectives of the SCPMS are:

- To characterize PM, its constituents, and precursors, to better understand sources and transport affecting human exposure, and to support development of State Implementation Plans (SIPs).
- To obtain atmospheric measurements to support health studies designed to address causal factors, etiologic pathways, and mechanisms of PM-related morbidity and mortality with particular emphasis on PM source-receptor-exposure-effects pathways.
- To conduct methods testing that will enable comparisons and evaluation of different technologies for characterizing PM including evaluation of new instrumentation, sampling methods, and federal reference methods.

The proposed SCPMS activities will be integrated with the multidisciplinary research in exposure assessment, toxicology, and epidemiology of the Southern California Center for Airborne Particulate Matter (SCCAPM). The SCPMS will interact with the ARB and the South Coast Air Quality Management District (AQMD) to maximize the use and value of the PM data collected by the SCPMS and other agencies.

The monitoring activities of the SCPMS will be also linked with toxicology studies in the Los Angeles basin using a mobile particulate matter concentrator facility to investigate health effects associated with exposures to ultrafine, fine, and coarse particles. These studies are funded by the SCCAPM, the Health Effects Institute, the ARB, and the National Institute of Environmental Health Sciences. The SCPMS will therefore become an invaluable resource to the major ongoing and planned PM health and modeling studies in the Los Angeles basin.

Specific projects in the category of PM characterization will provide the information that is needed to understand the relationship between PM sources and receptors, as well as providing insight into the factors that affect the spatial and temporal variability of PM characteristics. These projects are:

1) Comprehensive characterization of PM in the Los Angeles basin and correlations between particle size distribution, chemical composition, and gaseous co-pollutants.
2) Determination of the occurrence, frequency, and prevalence of $PM_{2.5}$ sub-modes in different locations of the Los Angeles basin.
3) Systematic evaluation of sampling artifacts of the FRM in measuring $PM_{2.5}$, PM_{10}, and coarse PM concentrations.
4) Study of PM formation and growth mechanisms in different locations of the Los Angeles basin.
5) Testing of the hypothesis that 2.5 µm represents a clear cutpoint between coarse and fine PM and does not depend on location or season.
6) Determination of the seasonal and spatial variation of ultrafine, accumulation, and coarse PM in the Los Angeles basin and their relation to sources. These studies will be conducted in collaboration with the South Coast AQMD and the ARB.
7) Comparison of the true $PM_{2.5}$, PM_{10}, and coarse PM concentrations with those determined gravimetrically with a FRM, and evaluation of sampling artifacts related to the loss of volatile or semi-volatile PM compounds.

A number of additional projects are proposed in the category of Support of Health Effects and Exposure Research. These projects include:

1) Detailed physico-chemical characterization of concentrated PM used in ongoing toxicity studies currently underway in the Los Angeles basin.
2) Measurement of within-community PM variability for improved dispersion models describing personal exposure indices based on traffic-based emissions for use in ongoing epidemiological investigations of chronic respiratory health effects of ambient particle matter in children.
3) Measurement of the size distribution as well as the spatial and seasonal variation of particle bound PAH, oxy-PAH, nitro-PAH, quinones, and other polar PAHs in the Los Angeles basin.
4) Determination of the contribution of volatile and semi-volatile species to total suspended $PM_{2.5}$ mass and assessment of any resulting bias in interpreting epidemiological results.

5) Measurement of aerosol oxidant partitioning in the ultrafine, accumulation, and coarse particulate matter modes.
6) Analysis of particle-bound PAH and related compounds as a function of distance from freeways.
7) Measurement of protein, allergens, and other biological constituents of urban airborne PM.

Finally, the four projects in the category of Methods Testing are:

1) Comparing the actual 24-hour averaged PM_{10} and $PM_{2.5}$ concentrations with those determined using continuous PM mass monitors, including the Scanning Mobility Particle Sizer (SMPS), Aerodynamic Particle Sizer (APS), Tapered Element Oscillating Microbalance, Continuous Ambient Mass Monitor and the Real-Time Ambient Monitor.
2) Comparing the real-time size distribution and mass concentration determined with the SMPS and APS with the 24-hour averaged mass-based size distribution measured with the MicroOrifice Uniform Deposit Impactor.
3) Development of a semi-continuous monitor for size-dependent nitrate, carbon, and sulfate measurements.
4) Evaluation and comparison of new and emerging measurement methods for single-particle analysis.

Intensive aerosol measurements that collect PM data beyond the traditional $PM_{2.5}$ mass, sulfate, and nitrate concentrations will be conducted in five discrete areas of the Los Angeles basin. These areas will be chosen to provide a wide geographical coverage, and thereby be as representative as possible of human exposures to these pollutants. A mobile Particle Instrumentation Unit, funded separately by the SCCAPM, will be deployed to these locations to conduct PM measurements. Sampling at each site will last for six months, and measurements will be repeated on a 2.5-year cycle. During the first of the six months, the Particle Instrumentation Unit will be deployed to five discrete locations downwind and one location upwind to a freeway close to the central site to determine PM characteristics as a function of distance from the freeway. A number of existing PM sites operated by the South Coast AQMD will be used as satellite sites, in addition to the five SCPMS sites, to obtain spatial PM variability in the Los Angeles basin as a function of size and composition.

B. California Regional PM_{10}/ $PM_{2.5}$ Air Quality Study (CRPAQS)

The California Regional $PM_{10}/PM_{2.5}$ Air Quality Study is a comprehensive, multi-year program designed to provide an improved scientific understanding of emissions, meteorology, and dynamic atmospheric processes leading to elevated PM concentrations and visibility impairment in central California (Magliano et al., 1999). As part of CRPAQS, major field monitoring campaigns are planned from December 1999 to January 2001. Additional information about this project can be found on the web at:

http://www.arb.ca.gov/airways/ccaqs/crpaqs.htm.

The objectives of the field programs are to collect an aerometric database of specified accuracy, precision, and validity to support the following:

- Refinement of conceptual models to explain the interactions among emissions, meteorology, and ambient PM concentrations.
- Evaluation and application of source and receptor oriented models to address the effects of emission control programs.
- Assessment of the extent to which the longer-term ARB/local air district monitoring networks represent population exposure under a variety of meteorological and emissions conditions.

The field data collection efforts will include four components: 1) a long-term program from December 1, 1999 through January 31, 2001; 2) a summer visibility program from June 15, 2000 through September 15, 2000; 3) a fall episodic program between October 1, 2000 and November 15, 2000; and 4) a winter episodic program occurring over 15 days between December 1, 2000 and January 31, 2001. The field measurements will be collected over a domain extending from the Pacific Ocean on the west to the Mojave Desert on the east and from the Tehachapi mountains on the south to the northern end of the Sacramento Valley. Monitoring sponsored by CRPAQS is intended to enhance the existing long-term monitoring networks operated by the ARB and local air districts.

The CRPAQS field measurements will include an upper air meteorological network of rawinsondes and radar profiler/RASS systems. The surface air quality network will consist of anchor sites with enhanced temporal resolution, measurement of precursor species and complete organic characterization, satellite sites to characterize inter- and intra-basin transport as well as near source concentrations, and a 100-meter tower to measure micrometeorological and air quality parameters. In addition, special studies will be conducted on intensive sampling days and will include aloft air quality measurements, single particle measurements, and fog chemistry.

C. California-Mexico Border Air Monitoring Program

Since 1992, the ARB has participated in cooperative air monitoring efforts in the California-Mexico border region with the U.S. EPA, the San Diego County and Imperial County APCDs, and Mexico's environmental regulatory agencies. The objective of the air monitoring program is the development of a database that will allow us to characterize the causes and severity of air pollution in the region, assess the extent of pollutant transport across the California-Mexico border, and develop strategies to improve air quality in the region.

The first station was established in 1992 in Tijuana. Since then, monitoring efforts have been expanded to include 5 stations in Tijuana, 1 in Rosarito, 1 in Tecate, 6 in Mexicali, and 2 in Calexico. The parameters currently monitored include ozone, nitrogen oxides, carbon monoxide, sulfur dioxide, PM_{10}, total suspended particulate,

toxics, and surface meteorology (wind speed, wind direction, and ambient temperature). However, not all parameters are monitored at all sites.

The ARB has plans to deploy eight continuous $PM_{2.5}$ Beta Attenuation Monitors in Mexico. Four of these monitors will be located in Tijuana, and the remaining four will be located in Mexicali. While the actual sites have not yet been selected, it is likely that the continuous $PM_{2.5}$ monitors will be located at stations that monitor the full complement of gaseous and particulate pollutants. In addition to the Mexico sites, continuous $PM_{2.5}$ monitors will be located at the two existing ARB sites in Calexico and at the San Diego County APCD site in Otay Mesa.

D. Dichotomous (Dichot) Sampler Network

California's dichot sampler network has been in operation since 1983. Until recently, the network comprised nearly 20 sites collecting 24-hour samples (midnight to midnight) every sixth day. The dichot sampler, or virtual impactor, uses a low-volume PM_{10} inlet followed by a virtual impactor which splits the air stream in two, separating particles into two fractions: fine particles (i.e., particles with aerodynamic diameters less than 2.5 microns or $PM_{2.5}$) and coarse particles (i.e., those having diameters of 2.5 to 10 microns). The sum of the fine and coarse fractions provides a measure of total PM_{10}. Both fractions collected by the dichot sampler are analyzed by X-ray fluorescence (XRF) spectroscopy for 30 elemental species.

With the implementation of the federally required $PM_{2.5}$ network, the ARB will be phasing out the dichot network. A number of sites were closed earlier this year. Four sites, Coso Junction, Keeler-Cerro Gordo Road, Taft College, and Victorville-Armagosa Road, were closed by early February. These sites have relatively low $PM_{2.5}$ concentrations and their closure does not impact ARB programs. A second group of sites were closed in early March. These sites have overlapping $PM_{2.5}$ FRM and dichot data that may be useful in determining correlations between the two types of measurements. If the data are highly correlated, the historical dichot data may be used to estimate long-term trends that are somewhat comparable to the continuing $PM_{2.5}$ FRM data. These long-term trends will be useful for identifying areas that do not meet the standards (however, because the dichot is not a FRM sampler, the data are not appropriate for determining attainment status). The dichot data may also be useful for refining the $PM_{2.5}$ FRM network, designing the SLAMS speciation network, and reviewing the impact of a potential coarse particulate matter standard in California. Seven sites are included in the second group: Azusa, Corcoran-Patterson, North Long Beach, Portola-Commercial Street, Riverside-Rubidoux, San Jose-4th Street, and Visalia-North Church Street.

The remaining dichot sites are still operating. These sites include Calexico-Ethel Street, Bakersfield-5558 California Avenue, Fresno-1st Street, Modesto-814 14th Street, Sacramento-T Street, and Stockton-Hazelton Street. The Calexico site is being maintained to support international transport assessment issues. The other five sites play an important role in the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS)

and health studies such as the Kaiser Central Valleys Study and the Childhood Asthma Study. These sites will continue operating until the studies are complete or data are no longer required.

E. California Acid Deposition Monitoring Program (CADMP)

The California Acid Deposition Monitoring Program (CADMP) was established in early 1988 to determine the spatial and temporal patterns of acidic pollutant concentrations in the State. The CADMP dry-deposition network initially comprised ten samplers located in Azusa, Bakersfield, Fremont, Gasquet, Long Beach, Los Angeles, Sacramento, Santa Barbara, Sequoia National Park, and Yosemite National Park. A collocated sampler was situated at the Sacramento site until July 1993, when it was moved to Azusa. Originally, the CADMP sampler had two units designed for collection of particulate species in two size fractions (PM_{10} and $PM_{2.5}$) and for collection of acidic gases. Concentrations of dry-deposition particles and gases were measured by collecting consecutive 12-hour daytime (0600 to 1800 PST) and nighttime (1800 to 0600 PST) samples, once every sixth day.

Over the years, as the data were reviewed and the limited extent of the acid deposition problem in California became known, the number of pollutants sampled and the number of sites declined. In September 1995, the CADMP network was reduced to five monitoring sites primarily in urban areas (i.e., Azusa, Bakersfield, Long Beach, Los Angeles, and Sacramento). The sample collection was changed from two 12-hour samples to one 24-hour sample beginning at midnight like the routine particulate matter monitoring network, and the sampling was reduced to $PM_{2.5}$ only. The ARB may discontinue the CADMP monitoring program relatively soon, as there are not sufficient resources to operate both the federally required $PM_{2.5}$ FRM network and the CADMP samplers.

F. PM_{10} Technical Enhancement Programs (PTEP and TEP 2000)

In December 1994, the South Coast Air Quality Management District (AQMD) initiated a comprehensive program, the PM_{10} Technical Enhancement Program (PTEP), to characterize fine particulate matter in the South Coast Air Basin. To build an optimal PM database for the 1997 PM_{10} State Implementation Plan and Air Quality Management Plan (AQMP) revision, a one-year special particulate monitoring program was initiated in January 1995 as part of the PTEP program. Under this enhanced monitoring, nitric acid, ammonia, and speciated PM_{10} and $PM_{2.5}$ concentrations were measured at five stations in the South Coast Air Basin and at one background station at San Nicholas Island, located 80 miles off the southern California coast. The PM_{10} data were the first speciated particulate data collected for air quality planning purposes in the South Coast Air Basin since 1986, and the $PM_{2.5}$ data were the first such speciated data collected in this area on an annual basis. The successful one-year PTEP monitoring program was essential to the modeling analysis and development of the 1997 AQMP.

As a sequel to the PTEP program, the South Coast AQMD initiated a comprehensive program (TEP 2000) to characterize the ozone and PM problem in the South Coast Air Basin for the upcoming 2000 AQMP. Under TEP 2000, the South Coast AQMD conducted a one-year special monitoring program in the South Coast Air Basin from August 1998 through July 1999. The program included eight sites: Downtown Los Angeles, Anaheim, Diamond Bar, Fontana, Rubidoux, Ontario, Long Beach, and Costa Mesa. Samplers at these sites operated on a 1-in-3 day sampling schedule. Three of the sites, Downtown Los Angeles, Anaheim, and Rubidoux, sampled daily during the peak October through November period. The TEP 2000 ambient monitoring program provided significantly more data for the chemical speciation required under the U.S. EPA's new PM regulatory standards and more complete data for receptor and dispersion modeling. For a detailed description of the PM sampler, sampling location and schedule, and sample analysis for the TEP 2000 program please refer to the $PM_{2.5}$ Air Monitoring Plan for the South Coast Air Quality Management District (South Coast AQMD, 1998).

G. Interagency Monitoring of PROtected Visual Environments (IMPROVE)

The 1977 amendments to the Federal Clean Air Act established a national goal to remedy and prevent future deterioration of visibility in Federal Class I national parks and wilderness areas. In response, federal land management agencies (National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Department of Agriculture Forest Service) and the U.S. EPA coordinated a visibility program, called IMPROVE (Interagency Monitoring for PROtected Visual Environments). The IMPROVE air monitoring network began operation in 1987 and is presently expanding to 110 sites nationwide. At a limited number of sites, the IMPROVE program includes the characterization of haze by photography and the measurement of optical extinction with transmissometers and nephelometers. The principle monitoring method at every IMPROVE site, however, is aerosol sampling to measure the composition and concentration of fine particles that produce haze.

Aerosol monitoring in the IMPROVE network is accomplished by a combination of particle sampling and sample analysis. The sampler was designed specifically for IMPROVE. It collects four simultaneous samples: one PM_{10} sample on a Teflon filter and three $PM_{2.5}$ samples on Teflon, nylon, and quartz filters. The sampling frequency is once every third day. The PM_{10} filter is used to determine total PM_{10} mass. The $PM_{2.5}$ Teflon filter is used to measure total fine aerosol mass, individual chemical species using Proton Induced X-ray Emission and Proton Elastic Scattering Analysis, and light-absorption coefficient using the Hybrid Integrating Plate and Sphere. The nylon filter is used to measure nitrate and sulfate aerosol concentrations with Ion Chromatography. Finally, the quartz filters are analyzed for organic and elemental carbon using the Thermal Optical Reflectance method.

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Appendix A: Core $PM_{2.5}$ State and Local Air Monitoring Stations

SQ	Federal Reference Method (FRM) $PM_{2.5}$ sequential sampler.
Col SQ	Collocated $PM_{2.5}$ FRM sequential samplers.
SCH	$PM_{2.5}$ FRM single channel sampler.
Col SCH	Collocated $PM_{2.5}$ FRM single channel samplers.

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Date of 1st Valid Sample	Sampling Schedule	Supporting Lab
Bay Area AQMD						
Concord-2975 Treat Blvd	060130002	BA	Col SQ	1/8/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
Fremont-Chapel Way	060011001	BA	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Livermore-793 Rincon Avenue	060010007	BA	SQ	12/2/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Redwood City	060811001	BA	Col SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
San Francisco-Arkansas Street	060750005	BA	SQ	1/3/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
San Jose-Tully Road	060852003	BA	SQ	1/3/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
San Jose-4th Street	060850004	BA	SQ	1/6/99	Everyday (Oct-March) 1 in 6 day (April-Sept)	BA
Santa Rosa-5th Street	060970003	BA	SQ	1/24/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Vallejo-304 Tuolumne Street	060950004	BA	SQ	2/20/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	BA
Coachella Valley						
Indio-Jackson Street	060652002	SC	Col SQ	1/30/99	1 in 3 day	SC
Palm Springs-Fire Station	060655001	SC	SQ	1/1/00	1 in 3 day	SC
Great Basin Unified APCD						
Keeler-Cerro Gordo Road	060271003	GBU	Col SQ	1/3/99	1 in 3 day	GBV
Mammoth Lakes-Gateway HC	060510001	GBU	SQ	Planned 6/00	1 in 3 day	GBV
Imperial County APCD						
Brawley-Main Street	060250003	IMP	SQ	1/3/99	1 in 3 day	SD
Calexico-Ethel Street	060250005	ARB	Col SQ	1/3/99	1 in 3 day	SD
El Centro-9th Street	060251003	IMP	SQ	1/3/99	1 in 3 day	SD
Lake County Air Basin						
Lakeport-Lakeport Blvd	060333001	LAK	SCH	1/6/99	1 in 6 day	BA
Lake Tahoe Air Basin						
North-West Lake Tahoe	Planned site	ARB	SCH	Not started	1 in 6 day	ARB
South Lake Tahoe-Sandy Way	060170011	ARB	Col SCH	2/5/99	1 in 6 day	ARB
Mojave Desert Air Basin						
Lancaster-W Pondera Street	060379002	MD	SQ	1/3/99	1 in 3 day	MD
Mojave-923 Poole Street	060290011	ARB	SQ	1/3/99	1 in 3 day	SD
Ridgecrest-Las Flores Avenue	060290012	KER	SQ	6/26/99	1 in 3 day	SD
Victorville-Armagosa Road	060710014	MD	Col SQ	1/3/99	1 in 3 day	MD

Appendix A (continued): Core $PM_{2.5}$ State and Local Air Monitoring Stations

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Date of 1st Valid Sample	Sampling Schedule	Supporting Lab
Monterey Bay Unified APCD						
Salinas-Natividad Road #2	060531002	MBU	SQ	1/15/99	1 in 6 day	BA
Santa Cruz-2544 Soquel Avenue	060870007	MBU	Col SQ	1/6/99	1 in 6 day	BA
Mountain Counties Air Basin						
Echo Summit	060170012	ARB	SQ	1/1/00	1 in 3 day	ARB
Grass Valley-Litton Building	060570005	NSI	SCH	1/3/99	1 in 6 day	ARB
Portola-Commercial Street	060631008	NSI	SQ	3/25/99	1 in 3 day	ARB
Quincy-N Church Street	060631006	NSI	SQ	3/26/99	1 in 3 day	ARB
San Andreas-Gold Strike Road	060090001	ARB	SCH	1/6/99	1 in 6 day	ARB
Truckee-Fire Station	060571001	NSI	Col SQ	3/31/99	1 in 3 day	ARB
North Coast Air Basin						
Eureka-Health Dept 6th and I Street	060231002	NCU	SCH	1/8/99	1 in 6 day	BA
Ukiah-County Library	060452001	MEN	Col SCH	1/7/99	1 in 6 day	BA
Northeast Plateau Air Basin						
Alturas-W 4th Street	060490001	SIS	SCH	1/18/99	1 in 6 day	ARB
Sacramento Valley Air Basin						
Chico-Manzanita Avenue	060070002	ARB	SCH	12/19/98	1 in 6 day	ARB
Colusa-Sunrise Blvd	060111002	ARB	SQ	12/16/98	1 in 3 day	ARB
Redding-Health Dept Roof	060890004	SHA	SCH	12/19/98	1 in 6 day	ARB
Roseville-N Sunrise Blvd	060610006	ARB	SCH	12/31/98	1 in 6 day	ARB
Sacramento-Del Paso Manor	060670006	SAC	Col SQ	1/3/99	Everyday (Oct-March) 1 in 3 day (April-Sept)	ARB
Sacramento-Health Dept Stockton Blvd	060674001	SAC	SQ	2/2/99	Everyday (Oct-March) 1 in 3 day (April-Sept)	ARB
Sacramento-T Street	060670010	ARB	SQ	12/13/98	Everyday	ARB
Woodland-Gibson Road	061131003	YS	SQ	1/9/99	1 in 3 day	ARB
Yuba City-Almond Street	061010003	ARB	Col SCH	12/19/98	1 in 6 day	ARB
San Diego County APCD						
Chula Vista	060730001	SD	SQ	1/3/99	1 in 3 day	SD
El Cajon-Redwood Avenue	060730003	SD	SQ	1/1/99	Everyday	SD
Escondido-E Valley Parkway	060731002	SD	SQ	1/1/99	Everyday	SD
San Diego-Overland Avenue	060730006	SD	Col SQ	1/3/99	1 in 3 day	SD
San Diego-12th Avenue	060731007	SD	SQ	1/1/99	Everyday	SD
San Joaquin Valley Unified APCD						
Bakersfield-Golden State Highway	060290010	ARB	SQ	1/6/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Bakersfield-"Southeast"	060290016	ARB	SQ	2/18/00	1 in 3 day	VEN
Bakersfield-5558 California Avenue	060290014	ARB	Col SQ	1/3/99	Everyday	VEN
Clovis-N Villa Avenue	060195001	SJV	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Corcoran-Patterson Avenue	060310004	SJV	SQ	1/3/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Fresno-Pacific Avenue	060192025	SJV	SQ	1/13/00	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Fresno-1st Street	060190008	ARB	Col SQ	1/3/99	Everyday	ARB
Merced-M Street	060472510	SJV	SQ	4/12/99	1 in 3 day (Oct-March) 1 in 6 day (April-Sept)	VEN
Modesto-814 14th Street	060990005	ARB	SQ	1/3/99	1 in 3 day	ARB
Stockton-Hazelton Street	060771002	ARB	SQ	1/3/99	1 in 3 day	ARB
Visalia-N Church Street	061072002	ARB	SQ	1/3/99	1 in 3 day	ARB

Appendix A (continued): Core $PM_{2.5}$ State and Local Air Monitoring Stations

Site Location (by MPA)	AIRS Site ID	Operating Agency*	Type of Monitor	Date of 1st Valid Sample	Sampling Schedule	Supporting Lab
San Luis Obispo County APCD						
Atascadero-Lewis Avenue	060798001	SLO	Col SCH	1/6/99	1 in 6 day	VEN
San Luis Obispo-Marsh Street	060792002	ARB	SCH	1/6/99	1 in 6 day	VEN
Santa Barbara County APCD						
Santa Barbara-W Carillo Street	060830010	ARB	SCH	1/6/99	1 in 6 day	VEN
Santa Maria-Library	060834001	ARB	SCH	8/4/99	1 in 6 day	VEN
South Coast Air Basin						
Anaheim-Harbor Blvd [1]	060590001	SC	Col SQ [1]	1/3/99	Everyday	SC
Azusa	060370002	SC	SQ [1]	1/4/99	Everyday	SC
Big Bear City-501 W Valley Blvd	060718001	SC	SQ	2/8/99	1 in 6 day	SC
Burbank-W Palm Avenue	060371002	SC	SQ	1/21/99	1 in 3 day	SC
Mission Viejo-26081 Via Pera	060592022	SC	SQ	6/8/99	1 in 3 day	SC
Fontana-Arrow Highway	060712002	SC	Col SQ	1/3/99	1 in 3 day	SC
Los Angeles-North Main Street	060371103	SC	Col SQ	1/20/99	Everyday	SC
Lynwood	060371301	SC	SQ	1/3/99	1 in 3 day	SC
North Long Beach [2]	060374002	SC	SQ	1/3/99	Everyday	SC
Ontario-1408 Francis Street	060710025	SC	SQ	1/3/99	1 in 3 day	SC
Pasadena-S Wilson Avenue	060372005	SC	SQ	3/4/99	1 in 3 day	SC
Pico Rivera	060371601	SC	SQ	1/15/99	1 in 3 day	SC
Reseda	060371201	SC	SQ	1/24/99	1 in 3 day	SC
Riverside-Magnolia	060651003	SC	SQ	1/6/99	1 in 3 day	SC
Riverside-Rubidoux	060658001	SC	Col SQ	1/3/99	Everyday	SC
San Bernardino-4th Street	060719004	SC	SQ	1/3/99	1 in 3 day	SC
Ventura County APCD						
El Rio-Rio Mesa School #2	061113001	VEN	SQ	1/9/99	1 in 3 day	VEN
Piru-Pacific Avenue	061110004	VEN	SQ	Planned 8/00	1 in 3 day	VEN
Simi Valley-Cochran Street	061112002	VEN	SQ	1/3/99	1 in 3 day	VEN
Thousand Oaks-Moorpark Road	061110007	VEN	Col SQ	1/3/99	1 in 3 day	VEN

***Key to Operating Agency Codes:**

ARB	Air Resources Board
BA	Bay Area Air Quality Management District
GBV	Great Basin Valleys Unified Air Pollution Control District
IMP	Imperial County Air Pollution Control District
KER	Kern County Air Pollution Control District
LAK	Lake County Air Quality Management District
MBU	Monterey Bay Unified Air Pollution Control District
MD	Mojave Desert Air Quality Management District
MEN	Mendocino County Air Quality Management District
NCU	North Coast Unified Air Quality Management District
NSI	Northern Sierra Air Quality Management District
SAC	Sacramento Metropolitan Air Quality Management District
SC	South Coast Air Quality Management District
SD	San Diego County Air Pollution Control District
SHA	Shasta County Air Quality Management District
SIS	Siskiyou County Air Pollution Control District
SJV	San Joaquin Valley Unified Air Pollution Control District
SLO	San Luis Obispo County Air Pollution Control District
VEN	Ventura County Air Pollution Control District
YS	Yolo-Solano County Air Quality Management District

1 The South Coast AQMD is relocating the Anaheim -Harbor Blvd site to a new site in the Anaheim area. Until a permanent Anaheim monitoring site begins operation, the collocated sampler will be relocated at the Azusa site.

2 The South Coast AQMD plans to move the $PM_{2.5}$ FRM sampler from the North Long Beach site to a new site in the South Long Beach area.

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Appendix B: Existing and Proposed $PM_{2.5}$ Monitoring Network in California

FRM	Federal Reference Method (FRM) $PM_{2.5}$ sequential or single channel mass sampler.
CMM	$PM_{2.5}$ continuous mass monitor.
Speciation	Included in this column are National Air Monitoring Station (NAMS) speciation trend sites and two IMPROVE sites that will be used for background monitoring. The State and local monitoring sites are not yet determined.
Dichot	Existing dichotomous samplers.
XX	Collocated $PM_{2.5}$ FRM monitoring instruments collecting precision data.
X-99	Funded in 1999.
X-00	Proposed deployment of a continuous $PM_{2.5}$ mass monitor in 2000. Section 103 Grant funding not used. See text in main body of report for details.
(NAMS)	Proposed designation as FRM NAMS site. See text in main body of report for details.

Site Location (by MPA)	AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
			FRM	CMM	Speciation	Dichot
Bay Area AQMD						
Concord-2975 Treat Blvd	060130002	BA	X			
Fremont-Chapel Way	060011001	BA	X			
Livermore-793 Rincon Avenue	060010007	BA	X	X-99		
Oakland area [1]	New site	BA		X-99 [1]		
Point Reyes		IMPROVE		X-99	IMPROVE	
Redwood City	060811001	BA	X			
San Francisco-Arkansas Street	060750005	BA	XX (NAMS)	X-99		
San Jose-Tully Road	060852003	BA	X (NAMS) [2]			
San Jose-4th Street	060850004	BA	XX (NAMS) [2]	X-99	NAMS	
Santa Rosa-5th Street	060970003	BA	X			
Vallejo-304 Tuolumne Street [3]	060950004	BA	X (NAMS)	X-00 [3]		
Coachella Valley						
Indio-Jackson Street [4]	060652002	SC	XX	X-00 [4]		
Palm Springs-Fire Station [4]	060655001	SC	X-99			
Great Basin Unified APCD						
Keeler-Cerro Gordo Road	060271003	GBU	XX			
Mammoth Lakes-Gateway HC [5]	060510001	GBU	X (NAMS) [5]	X-00 [5]		

[1] The ARB and the Bay Area AQMD will coordinate on the selection of a site in west Oakland.

[2] Either San Jose-Tully Road or San Jose-4th Street will be designated as a NAMS site. The ARB and the Bay Area AQMD will coordinate on the site selection when more data are available for evaluation.

[3] This site may not receive a State-provided continuous $PM_{2.5}$ mass monitor if insufficient monitors are available.

[4] Two continuous $PM_{2.5}$ mass monitors, currently deployed at the Indio-Jackson Street and Palm Springs-Fire Station sites as part of the Coachella Valley Health Study, will remain with the South Coast AQMD after the study. One will remain at the Indio-Jackson Street site and one will be relocated to a new site in the Anaheim area. A continuous PM_{10} mass monitor currently at the Palm Springs-Fire Station site will be modified for $PM_{2.5}$ and then be relocated to the Banning-Airport site.

[5] Mammoth Lakes and Quincy are both potentially smoke-impacted and we believe that a continuous $PM_{2.5}$ mass monitor should be deployed to one and that the FRM sampler at that site should be designated as a NAMS. Before a decision can be made, the involved agencies will need to coordinate on this, and more data may be needed from the recently opened Mammoth Lakes site.

Appendix B (cont): Existing and Proposed $PM_{2.5}$ Monitoring Network in California

Site Location (by MPA)	AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
			FRM	CMM	Speciation	Dichot
Imperial County APCD						
Brawley-Main Street	060250003	IMP	X			
Calexico-East	060250006	ARB		X-00		
Calexico-Ethel Street	060250005	ARB	XX (NAMS)	X-00		X
El Centro-9th Street	060251003	IMP	X			
Lake County Air Basin						
Lakeport-Lakeport Blvd	060333001	LAK	X			
Lake Tahoe Air Basin						
North-West Lake Tahoe	Planned site	ARB	X			
South Lake Tahoe-Sandy Way	060170005	ARB	XX			
Mojave Desert Air Basin [6]						
Lancaster-W Pondera Street	060379002	MD	X			
Mojave-923 Poole Street	060290011	ARB	X			
Ridgecrest-Las Flores Avenue	060290012	KER	X			
Victorville-Armagosa Road	060710014	MD	XX			
Monterey Bay Unified APCD						
Salinas-Natividad Road #2	060531002	MBU	X			
Santa Cruz-2544 Soquel Avenue	060870007	MBU	XX			
Mountain Counties Air Basin						
Echo Summit	060170012	ARB	X			
Grass Valley-Litton Building	060570005	NSI	X			
Portola-Commercial Street	060631008	NSI	X			
Quincy-N Church Street [7]	060631006	NSI	X (NAMS) [7]	X-00 [7]		
San Andreas-Gold Strike Road	060090001	ARB	X			
Truckee-Fire Station	060571001	NSI	XX			
Yosemite Village	060431001	tbd		X-99		
North Coast Air Basin						
Eureka-Health Dept 6th and I Street	060231002	NCU	X			
Ukiah-County Library	060452001	MEN	XX			
Northeast Plateau Air Basin						
Alturas-W 4th Street	060490001	SIS	X			

[6] This table does not include a Special Purpose Monitoring site located at Marine Corps Air Ground Combat Center Twentynine Palms. The site will include continuous and gravimetric $PM_{2.5}$ monitors. The site needs to be inspected and approved by the ARB's Monitoring and Laboratory Division before it is considered part of the routine network.

[7] Mammoth Lakes and Quincy are both potentially smoke-impacted and we believe that a continuous $PM_{2.5}$ mass monitor should be deployed to one and that the FRM sampler at that site should be designated as a NAMS. Before a decision can be made, the involved agencies will need to coordinate on this, and more data may be needed from the recently opened Mammoth Lakes site.

Appendix B (cont): Existing and Proposed $PM_{2.5}$ Monitoring Network in California

Site Location (by MPA)	AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
			FRM	CMM	Speciation	Dichot
Sacramento Valley Air Basin						
Chico-Manzanita Avenue	060070002	ARB	X			
Colusa-Sunrise Blvd [8]	060111002	ARB	X	X-00 [8]		
Elk Grove-Bruceville Road	060670011	SAC		X-00		
Redding-Health Dept Roof	060890004	SHA	X			
Roseville-N Sunrise Blvd	060610006	ARB	X			
Sacramento-Del Paso Manor	060670006	SAC	XX (NAMS)	X-99	NAMS	
Sacramento-Health Dept Stockton Bl	060674001	SAC	X			
Sacramento-T Street	060670010	ARB	X			X
Woodland-Gibson Road	061131003	YS	X			
Yuba City-Almond Street [8]	061010003	ARB	XX	X-00 [8]		
San Diego County APCD						
Chula Vista	060730001	SD	X			
El Cajon-Redwood Avenue	060730003	SD	X (NAMS)		NAMS	
Escondido-E Valley Parkway	060731002	SD	X	X-99		
Otay Mesa-Paseo International	060732007			X-00		
San Diego-Overland Avenue	060730006	SD	XX			
San Diego-12th Avenue	060731007	SD	X (NAMS)	X-00		
San Joaquin Valley Unified APCD						
Bakersfield-"Southeast"	060290016	ARB	X-99			
Bakersfield-1120 Golden State Ave	060290010	ARB	X			
Bakersfield-5558 California Avenue	060290014	ARB	XX (NAMS)	X-00	NAMS	X
Clovis-N Villa Avenue	060195001	SJV	X			
Corcoran-Patterson Avenue	060310004	SJV	X			
Fresno-Pacific Avenue	060192025	SJV	X-99			
Fresno-1st Street	060190008	ARB	XX (NAMS)	X-99	NAMS	X
Merced-M Street	060472510	SJV	X			
Modesto-814 14th Street [9]	060990005	ARB	X (NAMS)	X-00 [9]		X
Stockton-Hazelton Street [9]	060771002	ARB	X (NAMS)	X-00 [9]		X
Tracy	New site	SJV		X-99		
Visalia-N Church Street	061072002	ARB	X (NAMS)			
San Luis Obispo County APCD						
Atascadero-Lewis Avenue	060798001	SLO	XX			
San Luis Obispo-Marsh Street	060792002	ARB	X			
Santa Barbara County APCD						
Santa Barbara-W Carillo Street	060830010	ARB	X			
Santa Maria-Library	060834001	ARB	X			
San Rafael Wilderness		IMPROVE		X-99	IMPROVE	

[8] A continuous $PM_{2.5}$ mass monitor will be deployed to one of these sites to support the Sacramento Valley smoke management program.

[9] This site may not receive a State-provided continuous $PM_{2.5}$ mass monitor if insufficient monitors are available.

Appendix B (cont): Existing and Proposed $PM_{2.5}$ Monitoring Network in California

Site Location (by MPA)	AIRS Site ID	Operating Agency*	PM2.5 Sampling Method			
			FRM	CMM	Speciation	Dichot
South Coast Air Basin						
Anaheim area [10]	060590001	SC	X (NAMS)	X-99		
Azusa	060370002	SC	XX (NAMS)	X-00		
Banning-Airport [11]	060650012	SC		X-00 [11]		
Big Bear City-501 W Valley Blvd	060718001	SC	X			
Burbank-W Palm Avenue	060371002	SC	X (NAMS)	X-00		
Fontana-Arrow Highway	060712002	SC	XX			
Los Angeles-North Main Street	060371103	SC	XX (NAMS)	X-99		
Lynwood	060371301	SC	X			
Mission Viejo-26081 Via Pera	060592022	SC	X			
North Long Beach [12]	060374002	SC	X [12]	X-00 [12]		
Ontario-1408 Francis Street	060710025	SC	X			
Pasadena-S Wilson Avenue	060372005	SC	X			
Pico Rivera	060371601	SC	X			
Reseda	060371201	SC	X			
Riverside-Magnolia	060651003	SC	X			
Riverside-Rubidoux	060658001	SC	XX (NAMS)	X-99	NAMS	
San Bernardino-4th Street	060719004	SC	X			
South Long Beach area [12]	New Site	SC	X (NAMS) [12]	X-00 [12]		
Ventura County APCD						
El Rio-Rio Mesa School #2	061113001	VEN	X			
Piru-Pacific Avenue	061110004	VEN	X-99			
San Nicolas Island				X-99		
Simi Valley-Cochran Street	061112002	VEN	X (NAMS)	X-00	NAMS	
Thousand Oaks-Moorpark Road	061110007	VEN	XX			

***Key to Operating Agency Codes:**

ARB	Air Resources Board
BA	Bay Area Air Quality Management District
GBV	Great Basin Valleys Unified Air Pollution Control District
IMP	Imperial County Air Pollution Control District
IMPROVE	IMPROVE Steering Committee
KER	Kern County Air Pollution Control District
LAK	Lake County Air Quality Management District
MBU	Monterey Bay Unified Air Pollution Control District
MD	Mojave Desert Air Quality Management District
MEN	Mendocino County Air Quality Management District
NCU	North Coast Unified Air Quality Management District
NSI	Northern Sierra Air Quality Management District
SAC	Sacramento Metropolitan Air Quality Management District
SC	South Coast Air Quality Management District
SD	San Diego County Air Pollution Control District
SHA	Shasta County Air Quality Management District
SIS	Siskiyou County Air Pollution Control District
SJV	San Joaquin Valley Unified Air Pollution Control District
SLO	San Luis Obispo County Air Pollution Control District
VEN	Ventura County Air Pollution Control District
YS	Yolo-Solano County Air Quality Management District

[10] The South Coast AQMD is relocating the Anaheim-Harbor Blvd site to a new site in the Anaheim area.

[11] Two continuous $PM_{2.5}$ mass monitors, currently deployed at the Indio-Jackson Street and Palm Springs-Fire Station sites as part of the Coachella Valley Health Study, will remain with the South Coast AQMD after the study. One will remain at the Indio-Jackson Street site and one will be relocated to a new site in the Anaheim area. A continuous PM_{10} mass monitor currently at the Palm Springs-Fire Station site will be modified for $PM_{2.5}$ and then be relocated to the Banning-Airport site.

[12] The South Coast AQMD plans to move the $PM_{2.5}$ FRM sampler from the North Long Beach site to a new site in the South Long Beach area. If possible, the continuous $PM_{2.5}$ mass monitor will also be located at the new South Long Beach site.

Appendix C
Summary of Preliminary 1999 $PM_{2.5}$ Mass Data Collected at Core Sites

Site Name	AIRS Site ID	High 24-Hour Concentration $\mu g/m^3$	*Average of Quarters $\mu g/m^3$	*Valid?	†Number of Months	†Number of Quarters	‡Number of Observations
Bay Area AQMD							
Concord-2975 Treat Blvd	060130002	56.6	12.0	No	10	4	110
Fremont-Chapel Way	060011001	56.5	13.9	No	12	4	76
Livermore-793 Rincon Avenue	060010007	63.1	31.5	No	1	1	8
Redwood City	060811001	59.7	12.1	No	11	4	68
San Francisco-Arkansas Street	060750005	71.2	12.6	No	11	4	121
San Jose-Tully Road	060852003	77	14.5	No	10	4	117
San Jose-4th Street	060850004	70	12.3	No	10	4	117
Santa Rosa-5th Street	060970003	54.9	12.1	No	12	4	69
Vallejo-304 Tuolumne Street	060950004	90.5	14.1	No	10	4	63
Coachella Valley							
Indio-Jackson Street	060652002	29.6	12.8	No	10	4	83
Palm Springs-Fire Station (opened 1/00)	060655001			No	0	0	0
Great Basin Unified APCD							
Keeler-Cerro Gordo Road	060271003	40.7	7.2	No	10	4	69
Mammoth Lakes-Gateway HC (to open 6/00)	060510001			No	0	0	0
Imperial County APCD							
Brawley-Main Street	060250003	44.2	10.8	No	9	4	70
Calexico-Ethel Street	060250005	51.6	15.3	Yes	12	4	107
El Centro-9th Street	060251003	52.5	11.4	No	12	4	104
Lake County Air Basin							
Lakeport-Lakeport Blvd	060333001	27	6.1	No	12	4	55

* *Average of Quarters* and *Valid?* are calculated according to the methods specified in 40 CFR Part 50, Appendix N. Typically, a year is complete, and the *Average of Quarters* is therefore valid, if 75% or more of the expected measurements are available in each quarter. Under certain circumstances, however, an *Average of Quarters* can be deemed valid with fewer measurements (see 40 CFR Part 50, Appendix N for details).

† *Number of Months* and *Number of Quarters* are the number of months and number of quarters, respectively, that include at least one measurement.

‡ *Number of Observations* is the total number of 24-hour measurements represented at each site.

Appendix C (continued)
Summary of Preliminary 1999 $PM_{2.5}$ Mass Data Collected at Core Sites

Site Name	AIRS Site ID	High 24-hour Concentration $\mu g/m^3$	*Average of Quarters $\mu g/m^3$	*Valid?	†Number of Months	†Number of Quarters	‡Number of Observations
Lake Tahoe Air Basin							
North Lake Tahoe (planned site)	TBD			No	0	0	0
South Lake Tahoe-Sandy Way	060170005	21	8.3	Yes	12	4	59
Mojave Desert Air Basin							
Lancaster-W Pondera Street	060379002	25.5	10.8	Yes	12	4	113
Mojave-923 Poole Street	060290011	15.9	8.3	No	10	4	87
Ridgecrest-Las Flores Avenue	060290012	23.0	8.6	No	6	2	44
Victorville-Armagosa Road	060710014	24.3	11.8	Yes	12	4	111
Monterey Bay Unified APCD							
Salinas-Natividad Road #2	060531003	30.8	10.0	No	11	4	103
Santa Cruz-2544 Soquel Avenue	060870007	31.4	9.4	No	11	4	89
Mountain Counties Air Basin							
Echo Summit (opened 1/00)	060170012			No	0	0	0
Grass Valley-Litton Building	060570005	31	7.6	No	12	4	52
Portola-Commercial Street	060631008	70	13.9	No	10	4	73
Quincy-N Church Street	060631006	92	13.3	No	10	4	73
San Andreas-Gold Strike Road	060090001	33	11.1	Yes	12	4	59
Truckee-Fire Station	060571001	50	9.0	No	8	4	46

* *Average of Quarters* and *Valid?* are calculated according to the methods specified in 40 CFR Part 50, Appendix N. Typically, a year is complete, and the *Average of Quarters* is therefore valid, if 75% or more of the expected measurements are available in each quarter. Under certain circumstances, however, an *Average of Quarters* can be deemed valid with fewer measurements (see 40 CFR Part 50, Appendix N for details).

† *Number of Months* and *Number of Quarters* are the number of months and number of quarters, respectively, that include at least one measurement.

‡ *Number of Observations* is the total number of 24-hour measurements represented at each site.

Appendix C (continued)
Summary of Preliminary 1999 $PM_{2.5}$ Mass Data Collected at Core Sites

Site Name	AIRS Site ID	High 24-Hour Concentration $\mu g/m^3$	*Average of Quarters $\mu g/m^3$	*Valid?	†Number of Months	†Number of Quarters	‡Number of Observations
North Coast Air Basin							
Eureka-Health Dept 6th and I Street	060231002	36.9	9.2	Yes	12	4	59
Ukiah-County Library	060452001	35.6	8.9	Yes	12	4	58
Northeast Plateau Air Basin							
Alturas-W 4th Street	060490001	40	7.9	Yes	12	4	56
Sacramento Valley Air Basin							
Chico-Manzanita Avenue	060070002	73	17.5	Yes	12	4	59
Colusa-Sunrise Blvd	060111002	55	13.2	No	12	4	85
Redding-Health Dept Roof	060890004	57	12.9	Yes	12	4	57
Roseville-N Sunrise Blvd	060610006	79	13.4	Yes	12	4	59
Sacramento-Del Paso Manor	060670006	86[1]	21.2	No	9	3	124
Sacramento-Health Dept Stockton Blvd	060674001	86	16.2	Yes	11	4	158
Sacramento-T Street	060670010	108	17.0	Yes	12	4	264
Woodland-Gibson Road	061131003	70	16.3	Yes	11	4	98
Yuba City-Almond Street[2]	061010003	58	15.9	Yes	12	4	58
San Diego County APCD							
Chula Vista	060730001	47.2	14.4	Yes	12	4	111
El Cajon-Redwood Avenue	060730003	63.9	16.8	Yes	12	4	325
Escondido-E Valley Parkway	060731002	56.9	17.7	Yes	12	4	275
San Diego-Overland Avenue	060730006	43.5	13.8	Yes	12	4	97
San Diego-12th Avenue	060731007	46.4	17.6	Yes	12	4	289

* *Average of Quarters* and *Valid?* are calculated according to the methods specified in 40 CFR Part 50, Appendix N. Typically, a year is complete, and the *Average of Quarters* is therefore valid, if 75% or more of the expected measurements are available in each quarter. Under certain circumstances, however, an *Average of Quarters* can be deemed valid with fewer measurements (see 40 CFR Part 50, Appendix N for details).

† *Number of Months* and *Number of Quarters* are the number of months and number of quarters, respectively, that include at least one measurement.

‡ *Number of Observations* is the total number of 24-hour measurements represented at each site.

[1] High Concentration is from Sacramento-Del Paso Manor's collocated monitor.

[2] Yearly statistics from Yuba City-Almond Street's collocated monitor. The primary monitor's data were incomplete in 1999.

Appendix C (continued)
Summary of Preliminary 1999 $PM_{2.5}$ Mass Data Collected at Core Sites

Site Name	AIRS Site ID	High 24-Hour Concentration $\mu g/m^3$	*Average of Quarters $\mu g/m^3$	*Valid?	†Number of Months	†Number of Quarters	‡Number of Observations
San Joaquin Valley Unified APCD							
Bakersfield-Golden State Highway	060290014	133.9	26.2	Yes	12	4	84
Bakersfield-Southeast (opened 2/00)	060290016			No	0	0	0
Bakersfield-5558 California Avenue	060290010	134.8[3]	31.2[4]	Yes	12	4	294
Clovis-N Villa Avenue	060195001	97.7	19.8	Yes	12	4	82
Corcoran-Patterson Avenue	060310004	113.5	23.1	Yes	12	4	79
Fresno-Pacific Avenue (opened 1/00)	060192025			No	0	0	0
Fresno-1st Street	060190008	136	27.7	Yes	12	4	275
Merced-2334 M Street	060472510	108.7	22.6	No	9	3	53
Modesto-14th Street	060990005	108	24.9	Yes	12	4	117
Stockton-Hazelton Street	060771002	101	19.7	Yes	12	4	117
Visalia-N Church Street	061072002	123	27.6	Yes	12	4	117
San Luis Obispo County APCD							
Atascadero-Lewis Avenue	060798001	27.5[5]	9.6	Yes	12	4	59
San Luis Obispo-Marsh Street	060792002	20	8.2	Yes	12	4	54
Santa Barbara County APCD							
Santa Barbara-W Carillo Street	060834001	31	13.4	Yes	12	4	56
Santa Maria-Broadway	060830010	19.3	10.2	No	3	1	14

* *Average of Quarters* and *Valid?* are calculated according to the methods specified in 40 CFR Part 50, Appendix N. Typically, a year is complete, and the *Average of Quarters* is therefore valid, if 75% or more of the expected measurements are available in each quarter. Under certain circumstances, however, an *Average of Quarters* can be deemed valid with fewer measurements (see 40 CFR Part 50, Appendix N for details).

† *Number of Months* and *Number of Quarters* are the number of months and number of quarters, respectively, that include at least one measurement.

‡ *Number of Observations* is the total number of 24-hour measurements represented at each site.

[3] High Concentration is from Bakersfield-5558 California Avenue's collocated monitor.

[4] This average is from Bakersfield-5558 California Avenue's collocated monitor. While the collocated monitor reported only 79 measurements in 1999 (of 365 expected), this average is considered valid under the alternative completeness rules of 40 CFR Part 50, Appendix N. The average of quarters from Bakersfield-5558 California Avenue's primary monitor was 26.8 $\mu g/m^3$ in 1999.

[5] High Concentration is from Atascadero-Lewis Avenue's collocated monitor.

Appendix C (continued)
Summary of Preliminary 1999 $PM_{2.5}$ Mass Data Collected at Core Sites

Site Name	AIRS Site ID	High 24-Hour Concentration $\mu g/m^3$	*Average of Quarters $\mu g/m^3$	*Valid?	†Number of Months	†Number of Quarters	‡Number of Observations
South Coast Air Basin							
Anaheim-Harbor Blvd	060590001	68.6	25.9	No	8	4	92
Azusa	060370002	81.3	23.4	No	11	4	109
Big Bear City-501 W. Valley Blvd	060718001	32.1	10.3	Yes	11	4	97
Burbank-W Palm Avenue	060371002	79.4	22.9	Yes	12	4	106
Fontana-Arrow Highway	060712002	97.9	25.7	Yes	12	4	121
Los Angeles-North Main Street	060371103	69.3	23.0	Yes	12	4	136
Lynwood	060371301	67.7	24.3	Yes	12	4	110
Mission Viejo-26081 Via Pera	060592022	56.6	17.0	No	7	3	65
North Long Beach	060374002	66.9	20.7	Yes	12	4	148
Ontario-1408 Francis Street	060710025	85.8	25.4	Yes	12	4	96
Pasadena-S Wilson Avenue	060372005	73	19.9	No	10	4	95
Pico Rivera	060371601	85.6	25.7	Yes	12	4	111
Reseda	060371201	79	17.3	Yes	10	4	71
Riverside-Magnolia	060651003	89.9	26.7	Yes	12	4	110
Riverside-Rubidoux	060658001	111.2	31.0	Yes	12	4	137
San Bernardino-4th Street	060719004	121.4	25.6	Yes	12	4	104
Ventura County APCD							
El Rio-Rio Mesa School #2	061113001	36.7	12.2	No	12	4	92
Piru-Pacific Avenue (to open 8/00)	061110004			No	0	0	0
Simi Valley-Cochran Street	061112002	64.6	13.8	Yes	12	4	109
Thousand Oaks-Moorpark Road	061110007	53.2	11.8	Yes	12	4	110

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† *Number of Months* and *Number of Quarters* are the number of months and number of quarters, respectively, that include at least one measurement.

‡ *Number of Observations* is the total number of 24-hour measurements represented at each site.

Appendix D
Acronyms

ADAM: Aerometric Data Analysis and Management
AIRS-AQS: Aerometric Information Retreival System-Air Quality Subsystem
APCD: Air Pollution Control District
AQMD: Air Quality Management District
AQMP: Air Quality Management Plan
ARB: Air Resources Board
BAM: Beta Attenuation Monitor
CADMP: California Acid Deposition Monitoring Program
CFR: Code of Federal Regulations
CRPAQS: California Regional $PM_{10}/PM_{2.5}$ Air Quality Study
DGM: Dry gas meter
EC: Elemental carbon
EMPACT: Environmental Monitoring for Public Access and Community Tracking
FRM: Federal Reference Method
IC: Ion chromatography
IMPROVE: Interagency Monitoring of Protected Visual Environments
MFM: Mass flow meter
MPA: Monitoring Planning Area
NAMS: National Air Monitoring Station
NDEP: Nevada Division of Environmental Protection
OC: Organic carbon
PAMS: Photochemical Assessment Monitoring Station
PM: Particulate Matter
PM_{10}: Particulate Matter (0 to 10 microns aerodynamic diameter)
$PM_{2.5}$: Particulate Matter (0 to 2.5 microns aerodynamic diameter)
PMSA: Planning Metropolitan Statistical Area
PTEP: PM_{10} Technical Enhancement Program
QAPP: Quality Assurance Project Plan
R&P: Rupprecht & Patashnick
RAAS: Reference Ambient Air Sampler
SASS: Spiral Aerosol Speciation Sampler
SIP: State Implementation Plan
SLAMS: State and Local Air Monitoring Station
SPM: Special Purpose Monitoring
TC: Total carbon
TEOM: Tapered Element Oscillating Microbalances
TWS: Two-Week Sampler
U.S. EPA: United States Environmental Protection Agency
XRF: X-Ray Fluorescence